STABILISING GREEN HOUSE GAS (GHG) EMISSIONS FROM INDIAN POWER SECTOR THROUGH RENOVATION AND MODERNISATION OF THERMAL POWER PLANTS

Prepared for **Ministry of Environment and Forests**
Government of India

Submitted through **Project Management Cell**
TERI, New Delhi

February 2002

Central Electricity Authority,
Sewa Bhavan, R. K. Puram,
New Delhi

LIST OF ABBREVIATIONS

Abbreviation	Detail
AG&SP	Accelerated Generation and supply programme
APDP	Accelerated Power Development Programme
Aux. Consumption	Auxiliary Power Consumption
BHEL	Bharat Heavy Electricals Limited
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CLA	Central Loan Assistance
CPCB	Central Pollution Control Board
EoI	Expression of Interest
EPS	Electric Power Survey
ERCA	Electricity Regulatory Commission Act
GEF	Global Environment Facility
GGSSTP	Guru Gobind Singh Super Thermal Plant, Ropar
GHG	Green House Gases
GoI	Government of India
HR	Heat Rate
IEGC	Indian Electric Grid Code
IRR	Internal Rate of Return
Kcal	Kilo Calorie
KPCL	Karnataka Power Corporation Limited
LE	Life Extension
LEP	Life Extension Programme
MoE&F	Ministry of Environment & Forest
MoP	Ministry of Power
MW	Mega Watt
NGO	Non Governmental Organisations

Abbreviation	Detail
NIT	Notice Inviting Tender
NPV	Net Present Value
NTPC	National Thermal Power Corporation Limited
O&M	Operation and Maintenance
PFC	Power Finance Corporation Limited
PLF	Plant Load Factor
PMC	Project Monitoring Cell
R&M	Renovation and Modernisation
R&R	Reforms & Restructuring
RoR	Rate of Return
SEB	State Electricity Board
SERC	State Electricity Regulatory Commission
T&D	Transmission and Distribution
TPS	Thermal Power Station
UNDP	United Nation Development Programme
UNFCC	United Nations Framework on Climate Change

Table of Contents

1 PROJECT SUMMARY 3

2 PROJECT DESCRIPTION 11

2.1 PROJECT RATIONALE AND OBJECTIVE 11

2.2 CURRENT SITUATION 13

2.3 EXPECTED PROJECT OUTCOMES AND ASSUMPTIONS AND CONTEXT 14

2.4 ACTIVITIES AND FINANCIAL INPUTS NEEDED TO ENABLE THE CHANGES 15

2.5 SUSTAINABILITY ANALYSIS AND RISK ASSESSMENT 17

2.6 STAKEHOLDER INVOLVEMENT AND SOCIAL ASSESSMENT 19

2.7 INCREMENT COST ANALYSIS 20

2.8 BUDGET 21

2.9 IMPLEMENTATION PLAN 23

2.10 PUBLIC INVOLVEMENT 23

2.11 MONITORING & EVALUATION PLAN 24

2.12 TENDERING & PROCUREMENT PROCEDURE 25

2.12.1 Introduction 25

2.12.2 Procedures 25

3 ANNEXURES

Annexure - 1	Increment Cost Analysis
Annexure - 2	Brief Details on Electricity Scenario, Electricity Development and Future Projection in India
Annexure - 3	Brief Details on R&M Programme for TPS Undertaken in India
Annexure - 4	Brief Details on Environment Aspects Related to TPS in India
Annexure - 5	Other Initiatives Taken by GoI
Annexure - 6	Current Situation of State Electricity Board / Subsequent Generation Entities
Annexure - 7	Identified power plants for implementation of such schemes (List of 44 TPS)
Annexure - 8	Synopsis of the three power plants identified under GEF programme
Annexure - 9	Selection Criteria for identifying three power stations under GEF programme
Annexure - 10	Activities to be undertaken for the three identified thermal power stations
Annexure - 11	Write up on Justification of the activities to be undertaken
Annexure - 12	Technological barrier
Annexure - 13	Details of on going activities at three identified power stations
Annexure - 14	Distribution of Responsibilities for implementing the activities at three identified power stations
Annexure - 15	Project work plan
Annexure - 16	Letter from the stakeholders including NGO

1 PROJECT SUMMARY

PROJECT IDENTIFIERS

1. Project name

Stabilizing Green House Gas (GHG) Emissions from Indian Power Sector through Renovation and Modernisation of Thermal Power Stations

2. GEF Implementing Agency

United Nations Development Program (UNDP)

3. Country or countries in which project is being implemented

India

4. Countries eligibility

India has ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 1st November' 1993

5. GEF Focal Area (s)

Climate Change

6. Operational Program/ Short Term Measure

Operational Program # 5 "Removal of barriers to energy efficiency and energy conservation"

7. Project Linkage To National Priorities, Action Plans And Programs

The project is fully consistent and in conformity with the national objectives and priorities of Government of India (GoI). The priorities of GoI include Renovation and Modernisation of old power stations to improve their availability, output & reliability to reduce pollution. Presently, GoI is undertaking the R&M of thermal power stations under Accelerated Power Development Programme. In addition to APDP, GoI has further plan for undertaking R&M / LEP of Thermal Power Stations under 11th and 12th plan till 2011-2012.

The outcome after implementing the activities identified under GEF project will be in line with the national priorities viz. quality power, economical generation by reduction of coal consumption, improvement in local and global environment and reliability of power. Improvement in electricity sector will have significant impact on national growth as electricity being the important input for growth of all the sectors in the country.

The project under GEF programme will complement the efforts of GoI for improving the performance of the thermal power stations. Since 1984, several R&M programmes were implemented and several activities for increasing the output and reducing pollution are completed, bringing good results.

8. GEF National Operational Focal Point And Date Of Country Endorsement

Name – Mr. Rajeev Kher
Title – Additional Secretary
Organisation - MoEF
Date -

9.0 PROJECT RATIONALE AND OBJECTIVES

Logical Framework Approach and Project Planning Matrix

Project Strategy	Objectively Verifiable Indicators	Means of Verification	Assumptions
Development Objective: Promote the efficient use of fossil fuel (Coal) in generation of electricity leading to significant reduction in Heat Rate below the present level of Heat Rate leading to substantial reduction in GHG emission having significant global importance	• Heat rate reduction in the three identified power stations within one year of completion of project • Programs put in place to be continued in other thermal power stations	• Monthly / quarterly operating reports from power plants • Implementation of program after GEF project ends	• Business as usual projection reasonable • Proposed schemes will culminate into achieving desired efficient use of fuel • Project budget sufficient to produce these outputs • Smooth flow and availability of funds for replicating such schemes at other power stations
Immediate Objectives: • To implement efficiency improvement R&M schemes in three identified power stations and removing technological barrier in retrofitting efficient equipments.	• Successful implementation of efficiency improvement scheme in the identified power plants with better technologies.	• Progress reports • Site inspection	• The schemes identified on the basis of feasibility studies. Detailed engineering yet to be done

Project Strategy	Objectively Verifiable Indicators	Means of Verification	Assumptions
To remove financial constraints.	Power plant authorities and financial institutions are ready to invest	Flow of funds	Funds are availa Financial viab established
To remove barrier of lack of information (awareness) among the various stake holders	Willingness to take up efficient improvement program	Survey report	
Outputs:			
Reduction in the station heat rate	Station heat rate	Performance testing/ Energy audit report	
Reduced operating cost	Fuel cost per unit generation Repair & maintenance cost	Report on Fuel expenses Maintenance cost report	No fuel escalation Constant Prices : Labour and spar
Improved availability and output	Plant Load Factor Nos. and duration of outages	Station annual report Station Monthly reports	
Improved technologies	Predictable parameters	Log sheets & performance report	
Financial mechanism evolved	Financial mechanism	Commitment from funding agencies	Availability funding resource
Increased awareness	Knowledge	Survey reports	
Enhanced capability of operating staff.	Individual performance	Performance records	

Project Strategy	Objectively Verifiable Indicators	Means of Verification	Assumptions
Activities **-Implementation of efficiency improvement R&M schemes**			
• Formation of the Project Implementation Teams as well as Project Monitoring Teams	• Teams formation along with defined responsibilities	• Project progress report	
• Appointment of consultant for engineering and projects monitoring services	• Consultant appointment	• Project progress report	
• Preparation of specifications	• Specification prepared	• Project progress report	
• NIT and tendering	• Issue of NIT	• Project progress report	
• Bid evaluation and award of contracts for implementation	• Bids evaluated and contracts awarded	• Project progress report	• Timely cash flow and material delivery
• Execution of technical schemes	• Work progress	• Project progress report	• Generating unit shut down as per plan
• Project Evaluation, monitoring and support	• Project evaluation, tests & surveys	• Evaluation, test & survey reports	
- Evolving Financial Mechanism			
• Appointment of financial consultant	• Consultant appointment	• Project progress report	

Project Strategy	Objectively Verifiable Indicators	Means of Verification	Assumptions
• Interaction with funding agencies/equipment manufacturers	• Consultation / Workshops held	• Project progress report	
-Increasing Awareness / Training			
• Appointment of Consultant	• Consultant Appointed	• Project Progress Report	
• Organising workshops / seminars for spreading awareness and visits	• Workshop / seminars held.	• Program report	
• Institutional training for power plant personnel	• Training programs held	○ Program reports • Feed backs from participants	
• Procurement of Training Equipments	• Equipment Procured and Installed	• Progress Report / Physical Inspection	

* For activity wise cost break-up refer Table 1

10. Estimated Budget in Million US $

GEF - 91.755

Co – financing - 35. 60

(GoI Grant and Indian FIs)

Total - 127.355

INFORMATION OF INSTITUTION SUBMITTING PROJECT BRIEF

11. Information on the Project Proposer

Ministry of Environment & Forest / Government of India

12. Information on Proposed Executing Agency

Central Electricity Authority / Power Utilities / State Electricity Boards

13. Date of Initial Submission of Project Concept

INFORMATION TO BE COMPLETED BY IMPLEMENTING AGENCY

14. Project Identification Number

15. Implementing agency contact person

16. Project Linkage to Implementing agency Program

TABLE – 1 ACTIVITY WISE ESTIMATE (IN MILLION DOLLARS) US $ 1 = Rs. 48

SN	Activity	GEF		Co-financing
		Overall	Risk Capital included in overall	
1	**Implementation of efficiency improvement R&M schemes**	91.19	33.33	35.60
	a) Formation of the Project Implementation Teams as well as Project Monitoring Teams	Covered in 1(f)		
	b) Appointment of consultant for engineering and projects monitoring services	0.6		
	c) Preparation of specifications	Covered in 1(b)		
	d) NIT and tendering	Covered in 1(b)		
	e) Bid evaluation and award of contracts for implementation	Covered in 1(b)		
	f) Execution of technical schemes	90.44		
	g) Project Evaluation, monitoring and support	0.15		
2	**-Evolving Financial Mechanism**	0.1	-	-
	a) Appointment of financial consultant	Covered in 2		
	b) Interaction with funding agencies/equipment manufacturers	Covered in 2		
3	**Increasing Awareness / Training**	0.415	-	-
	a) Appointment of Consultant	0.1		
	b) Organising workshops / seminars for spreading awareness and visits	0.225		
	c) Institutional training for power plant personnel	Covered in 3(b)		
	d) Procurement of Training Equipments	0.09		
4	Miscellaneous (Publication etc)	0.05	-	-
	Total(1+2+3+4)	91.755	33.33	35.6

2 Project Description

2.1 Project Rationale And Objective

The proposed project under GEF Scheme titled "Stabilizing Green House Gas (GHG) Emissions from Indian Power Sector through Renovation and Modernisation of Thermal Power Stations" is intended to achieve improvement in thermal efficiency of coal based power stations. Improvement in plant efficiency will bring down the high level of consumption of coal per unit of electricity produced in Indian power stations and will ultimately reduce the Green House Gases Emissions.

Other objectives of this project under GEF programme are to address various barriers, which are seen as main obstacles in bringing improvement on efficient operation of thermal power stations in India. Further details on the objectives and outcomes of this project are mentioned in the logical framework given at point 9 of Project summary.

Presently, many of the coal based thermal power stations, which were installed a few decades ago or even in late 80's, are functioning much below their designed level of performance and efficiency. Major causes of such poor efficiency of coal based thermal power stations in Indian Power Sector are:

- Technological barriers in adoption of modern practices/equipment for better performance
- Financial constraints for implementing regular efficiency improvement schemes
- Lack of awareness on modern technological developments in power sector and in prudent utility practices in carrying out efficient operation & maintenance.
- Lack of state of the art control and instrumentation
- Lack of training and exposure to modern techniques in unit operation

GoI has taken the lead to redress the prevailing deficiencies in managing the power generation scenario, by way of bringing out several financial schemes for implementation of technical programs, in order to ensure output and environment improvement. Presently the project under GEF programme will complement the efforts of Government of India (GoI) in achieving environmental friendly operation of thermal power stations. Since 1984, several R&M programmes were implemented, several activities for increasing the output and reducing pollution have been completed, bringing in good results. Presently

GoI has taken up initiative for encouraging R&M schemes for coal based thermal powe stations under Accelerated Power Development Programme (APDP) in association wit financial institutions. Further details on the R&M of TPS are mentioned under Annexure 3.

UNDP has brought out scheme on climatic change where in programmes related t bringing reduction in GHG emission under Global Environmental Facility could be take up. India is eligible to get financing for such programmes. India has ratified the Unite Nations Framework Convention on Climate Change (UNFCCC) on 1st November' 1993 The identified project is covered under Operational Program 5 (Removal of Barriers t Energy Efficiency and Energy Conservation) of Global Environment Facility (GEF). Ove the years, GoI has brought notified norms for environmental friendly operation of TPS and these guidelines / act are briefly mentioned under Annexure - 4 (Titled Environmental Aspects Related to TPS in India)

The outcome of implementation of the activities identified under GEF programme will be in line with the national priorities viz. quality power, economical generation by reduction of coal consumption & other operating cost improvement in local and global environment and reliability of power. Noticeable improvement in electricity sector will have significant impact on national growth, as electricity is the important input for growth of all other sectors in the country.

As mentioned in Annexure - 7. 44 TPS have been identified, which are at present operating below the level of national average thermal efficiency (in other terms heat rate). Thus, on implementation of such schemes on all the identified TPS, there will be substantial reduction in GHG emissions, which will play a significant role in protection of global environment.

As one of the objective under this programme is to prove the techno-economic viability and effectiveness of efficiency improvement schemes to all the power stations, which are under performing, by way of implementation in three (3) of the specifically selected power stations (namely Kolaghat TPS, Faridaad TPS and GGSSTP Ropar), as a pilot programme and spread the awareness among others, for paying attention in bringing improvement on efficient operation of their TPS. Thus this programme will induce vigour and enthuse other power plants to emulate & improve the overall efficiency of their TPS on a regular basis. Hence the project has a status of country driven project.

2.2 Current Situation

Presently GoI is implementing R&M schemes in the existing poorly performing TPS under APDP. GoI has already sanctioned various schemes for R&M / LEP in 15 TPS amounting to Rs. 4750 Millions under APDP till 30th September'2001. Thus the R&M schemes under APDP are considered as baseline course of action for improving the performance of the existing old power stations.

Due to the fact that the country is facing acute power shortage, the thrust area of on-going R&M activities is on enhancing availability of generating units, present level of generation, reliability and bringing improvement in environmental conditions and safety. The present scenario of electricity sector is briefly covered in Clause - 2.2 of the Annexure - 2 of this report. Presently, there is energy shortage of 6.9% and peaking shortages of 12.5% in the country. As per the power demand projections, the demand is projected to increase at annual growth rate of 7 – 8 % per annum. To meet the projected demand GoI is contemplating massive capacity addition programme consisting of about 1,00,000 MW in next decade. Additionally, certain short term measures have also been formulated which include renovation and modernisation including life extension works in existing old power station to improve their availability and PLF. CEA has formulated a National Perspective Plan for R&M and LE of TPS till the end of 11th Plan (2012). In this Plan, R&M requirement of TPS in the country has been worked out. The Plan also has identified the Power Plants, which will become due for LEP during the next 10 years. It is estimated that the funds to a level of Rs. 168.02 billion would be needed in next ten years for taking-up R & M and LEP activities in these TPS.

Presently the financial position of a number of state electricity boards / power utilities owning power stations is weak due to the fact that there is significant subsidy given to special sector by the government as well as due to unchecked high T&D losses. In order to strengthen the financial conditions of SEBs, GoI has taken many initiatives to improve the operational and financial management of the boards. Brief details on the initiatives taken by GoI for improving the power sectors and current status of reform process in state electricity boards are respectively mentioned under Annexure - 5 and Annexure - 6.

The consumption of coal by TPS in India during 1999-2000 was 220.74 Million Tonnes. The estimated CO_2 Emission in this year was 357.67 Million Tonnes, which works out to 1.15 kg of CO_2 per Kwhr. This is considered to be very high. The high CO_2 emission is reflection of poor thermal efficiency of coal fired TPS. This is further corroborated by the details given under Annexure – 7, showing existing 44 TPS in which the average Station Heat Rate exceeds by more than 10% from their design value. Out of these 44 stations, in 28 power stations, the station heat rate is deviating by more than 20% from the desi values.

The proposed project under GEF programme is R&M of existing TPS. No land acquisiti and ousting of landowners are involved under this programme. There is no ne displacement of habitation in the surrounding area. The environmental assumption is th present emission norms and air quality norms will remain in force without any change an that there will not be any new environmental protection law / norms, which could force th inefficient power station to be shut down. The other developmental assumption is th the prevailing situation of power shortages will continue in spite of the massive capaci addition programme envisaged in the country and other initiative taken by GoI, so th existing power plants will be called upon to run for the next 15 years.

2.3 Expected Project Outcomes and Assumptions and Context

As mentioned in above clause 2.2, the R&M schemes for TPS undertaken by GoI are focussed on enhancement of generation, reliability and reducing pollution, whereas the project proposed under GEF programme is primarily intended for improvement in therma efficiency of TPS.

The developmental objective of this project is to promote the efficient use of fossil fue (Coal) in generation of electricity, bringing significant reduction in Heat Rate from the present level, leading to substantial reduction in GHG emission and having significant global importance. As a pilot programme initially, three TPS out of the 44 inefficient thermal power stations, have been identified for implementation of proposed R&M schemes to demonstrate the benefits. The selection criteria of identifying these three TPS are mentioned in Annexure - 9. Also enclosed is the synopsis of present status of identified three TPS in Annexure - 8 of this report. Certain R&M works at these three TPS had already been identified under APDP (Baseline), details of which are given in Annexure – 13. Majority of the identified R&M works under APDP are in fact delayed maintenance activities since the power plants could not carry out regular maintenance due to shortage of funds. The other thrust area of these R&M works is to improve generation, local environment and safety. Under the proposed GEF project, the R&M activities at these stations are to be complemented by undertaking some major efficiency improvement schemes, - details of which are given in Annexure – 10. Some of the proposed R&M works will involve major modifications / retrofitting of existing equipment. The power stations have been reluctant to carry out these activities because of the risk involved, even though the manufacturers (OEM) had confirmed the technical viability of implementing the same for improvement of efficiency. As such the project will address these technological barriers (details given in Annexure. 12).

The R&M schemes identified under GEF project, will bring remarkable and sustainable improvement in the overall efficiency of the plants. A note on details on the necessity and benefits of the proposed R&M schemes are mentioned in Annexure - 11 of this report. The Implementation of R&M schemes at three identified power station will bring down the Heat Rate of these TPS consequently the CO_2 emission as per details given below Table - 1.

Table – 1 Reduction in Station Heat Rate (net) and reduction in CO_2 emission after GEF Project

SN	Thermal Power Station	Reduction in Heat Rate		Reduction in CO_2 emission	
		In Kcal / Kwhr	% reduction from baseline level (As of APDP)	Reduction of CO_2 per unit (Kg/Kwhr)	Reduction of CO_2 per annum (average) in Million Tonnes
1.	Kolaghat TPS	351.7	10.25	0.140	0.951
2.	Faridabad TPS	818.68	17.37	0.358	0.333
3.	GGSSTP, Ropar	100.6	3.36	0.037	0.309

Note – 1 The above Heat Rate reduction includes benefits of reduction in auxiliary power reduction.

2 The reduction in Co2 emission in Million tonnes has been estimated Considering generation level same as in baseline.

The other outputs expected after implementation of R&M works under GEF project at three power stations are reduced operating cost, improved availability (PLF) as per details given in Annexure – 1 for each power station.

In order to achieve further environmental benefits, similar approach for improving the efficiency of balance 41 Thermal Power Stations will be undertaken by overcoming other barriers, including financial and awareness. With the above approach, the project will reap the best of the results on a sustainable long-term basis.

2.4 Activities And Financial Inputs Needed To Enable The Changes

The activities proposed under the project (alternative course of action) are as follows:

(A) Implementation of R&M schemes as per details given in Annexure –10 in three identified TPS for efficient operation as well as to overcome the technological barriers. The sub activities are briefly indicated below:

- Project Implementation and Monitoring Teams will be formulated.
- A reputed consultant shall be appointed (one for each TPS) for engineering and assistance in project monitoring and supervision, evaluation services.
- The technical specifications will be prepared by SEB / consultants.
- SEB will float the NIT and call for tenders / EoIs from the reputed contractors for execution of the schemes.
- Bid evaluation and award of contracts for implementation will be carried out by the consultants / SEBs.
- Execution of technical schemes will be undertaken by the contractors under supervision of the SEB / consultant.
- Project Evaluation, monitoring and support will be provided by the consultant under overall supervision of SEB / CEA.

(B) Development of a financial Mechanism for funding such schemes in other power stations in India. This will include following major sub-activities:

- A reputed financial consultant shall be appointed by CEA / MoP for evolving innovative financial mechanism for undertaking similar schemes at remaining power plants.
- Interaction with funding agencies/equipment manufacturers will be carried by the financial consultant / CEA / MoP through meetings/ workshops

(C) Awareness among various stake holders and Training of the O&M personnel for efficient operation of thermal power projects

- A reputed consultant shall be appointed to evolve an effective awareness/training programme.
- Workshops / seminars shall be organised by the consultant under the supervision of CEA/MoP for spreading awareness
- Institutional training for power plant personnel shall be organised by the consultant under the supervision of CEA/MoP
- Two simplified version of simulators will be procured for installation at two of the identified TPS.

The total cost for the implementation of activities identified under GEF programme is estimated to be US$ 91.775 Million dollars. The cost of scheme under GEF programme is over the baseline activities, taken up under APDP program, to be implemented in the country. The activity wise cost details are given in Table – 1 of project summary.

Concurrently, the benefits after implementation of GEF schemes will also meet national objectives as mentioned below:

- improvement in local environmental conditions
- Improvement in Plant Reliability, availability and deliverance of quality power, ultimately having positive impact on the overall growth of the nation
- Economical generation cost due to reduction in coal consumption and other operating cost.
- Enhancement of capability of O&M staff after training, as proposed under GEF programme for efficient operation of TPS

2.5 Sustainability Analysis and Risk Assessment

The schemes identified under GEF programme are techno commercially viable. Few of significant parameters for assessing the viability are mentioned in the Table - 2. The viability of the project is calculated based on the consideration that the cost incurred are the capital cost.

Table - 2 Returns on Implementation of the Schemes Under GEF Programme at a Glance

Sn	Parameter	Kolaghat TPS	Faridabad TPS	GGSSTP, Ropar
1	Pay back period in Years	3.05	1.9	3.57
2	IRR in %	23.69	36.41	20.00

For further details on above benefits, please refer the Annexure -1 (Incremental Cost Analysis)

It is envisaged that after implementation of identified activities in three power stations under GEF Programme, similar schemes for improving the efficiency of thermal power stations will be replicated at remaining 41 TPS.

The implementation will be achieved with the initiatives as mentioned in project summary under the GEF Programme, which are as follows:

- Spreading of awareness among various stakeholders including Financial Institutions, Power Generating Utilities, and Electricity Regulatory Commissions etc.

- To develop financial mechanism in consultation with the Financial Institutions, Power Plant Authorities and Financial Consultant (Financial Consultant shall be appointed during the course of implementation of this project under GEF Programme).

As it is evident from the analysis carried out for the viability of the schemes at three power stations that the improvement in operation efficiency of thermal power station will result into substantial savings in the revenue expenditure. The reduction will be directly attributable to saving on account of reduction in fuel consumption as well as other associated expenses related to Operation and Maintenance.

On reviewing the scope of improvement in present heat rate of identified 41 TPS for replication of efficiency improvement schemes, it is envisaged that the implementation of efficiency improvement schemes in these power plants will be bankable and self sustainable in context with financial returns. In such a way, during the implementation of schemes under GEF Programme for three Power Stations, the financial Institutions will be convinced to lend the money to generating utilities for implementing such schemes.

The major risks involved in realising overall objectives are as follows:

Technological risk:

As mentioned in Annexure - 12 (Titled - Technology Barriers), a few of the modifications have been considered as the technological risks as these modifications will finally result into change of earlier design philosophy. However, this has been reviewed thoroughly and the original manufacturers have been consulted before taking up such schemes under the GEF programme.

Financial risk:

The Indian Financial Institutions and the equipment manufacturers may not be able to provide the required funds for replication of the R&M schemes in all other identified power stations. To overcome this risk, International-funding agencies shall be approached. If required, GoI shall be approached for providing funding for efficiency improvement R&M schemes in other power stations.

Lack of Response from power station authorities for replicating of the schemes:

There could be lack of response even after conducting awareness program as proposed under the project for replicating the R&M schemes in some thermal power stations. In such a situation following policy initiatives could be undertaken:

- Incentive schemes shall be formulated for cash award to the power plants for improvement of overall heat rate.
- The government shall be approached for directions to regulatory commissions to enforce implementation of R&M schemes to improve efficiency to the specified levels.

2.6 Stakeholder Involvement and Social Assessment

During the preparation of Project, various stakeholders viz SEB/ Utility companies, Regulators, NGO, Pollution Control Board, Environmental agencies etc. have been consulted. The project has received overwhelming support of all the stakeholders. The support letters from following agencies are enclosed under Annexure -16.

For Kolaghat TPS

Kolaghat Thermal Power Station, West Bengal Power Development Corporation Ltd.

West Bengal State Electricity Board, Kolkata

W.B. Electricity Regulatory Commission, Kolkata

West Bengal Pollution Control Board, Kolkata

Kolaghat Building Centre, Midnapore

Forum of Scientists, Engineers and Technologists (FOSET), Kolkata

For Faridabad TPS

Faridabad Thermal Power Station, Haryana Power Generation Corporation Ltd.

Haryana State Pollution Control Board, Chandigarh

Haryana Vidyut Prasaran Nigam, Panchkula
Haryana Electricity Regulatory Commission, Panchkula
Rashtriya Chetnashakti Foundation, Faridabad
Green Cross Society, Gurgoan

For Guru Gobind Singh Super TPS, Ropar
Guru Gobind Singh Super Thermal Plant (Punjab State Electricity Board)
Punjab Pollution Control Board, Chandigarh
Punjab State Electricity Regulation Commission
Ropar Thermal & Ambuja Affected Committee (Ropar)

2.7 Increment Cost Analysis

The R&M schemes going to be undertaken under APDP are considered to be the baseline. As the baseline objectives in the country are driven with the fact that there is significant gap between supply and demand of power. The primary focus of the GoI is to enhance the availability by implementing the R&M schemes at TPS.

Incremental cost assessment has been done by computing cost and benefit both (local and global) for next fifteen years. The various cost streams have been levelised taking 12% discount factor assuming the constant prices. Both cost and benefits have been normalised with the generation. Detailed calculations are given in Annexure –1. The incremental cost per tonne of CO_2 abatement works out as follows:

Table - 3 Incremental cost per Tonne of CO_2

Sn	Parameter	Kolaghat TPS	Faridabad TPS	GGSSTP, Ropar
1	CO_2 abatement Rupees per tonne	-32.50 (US$ -0.677)	-112.13 (US$ -2.33)	-27.18 (US$ -0.566)

The scheme under GEF programme is focussed on improvement in efficiency of TPS. As mentioned above the schemes under GEF programme will bring into substantial protection to the global environment, by the way of reduction in GHG emissions.

The financial mechanism is proposed to be evolved for implementing such schemes at other TPS. This will make the process of funding such schemes self sustaining and further details are mentioned in clause 2.5.

The funds available as co-financing is mentioned in Point 12 of Project summary above.

2.8 Budget

SN	Description	Amount in US $ (million)	Remarks
1	PDF	-	-
2	Personnel	0.8	0.6 for technical consultant, 0.1 for consultant for evolving financial mechanism and 0.1 for awareness/training program.
3	Subcontracts	90.44	List of activities are mentioned in Annexure - 10
4	Training / Workshop	0.2	For modules/ seminar
5	Training Equipment	0.09	Two Simplified Version of Simulators
6	Travel	0.075	120 Man visits considered to visit three plant sites for regular monitoring over three years equivalent to 0.05 Million and 60 Man visits at various location for spreading awareness equivalent to 0.025.
7	Evaluation Mission	0.1	For functioning of PMC under CEA
8	Miscellaneous	0.05	Publication
	Total	91.755	

2.9 Implementation Plan

The project is likely to be completed in 62 months. The activity work bar chart is enclosed at Annexure - 15.

2.10 Public Involvement

Stakeholder Identification

The Stakeholders who will be executing, co-executing or all as collaborators in the project activities are as follows:

i) The Power utilities and State Electricity Boards who own the Power Plant will be executing the R&M schemes in their respective power stations through the consultant and contactors. For the Pilot Project the Power Utilities/ SEB are:-

West Bengal Power Development Corp. Ltd. (WBSPDCL) in respect of Kolagaht TPS/ Haryana Power Generation Corpn. Ltd. (HPGCL) in respect of Faridabad TPS and Punjab State Electricity Board (PSEB) in respect of GGSSTP, Ropar.

ii) CEA will be the co-executing agency by overseeing and monitoring the progress of work for the R&M schemes and taking care of fund allocation and disbursement to the power utilities/SEB. CEA will be responsible evolving financial mechanism as well as for conducting awareness programme in consultation with MOP, GOI, for replication of the R&M scheme in the remaining power stations. CEA will also be responsible for evolving the training programme in consultation with MOP, GOI and National Power Training Institute for the operation and maintenance staff of various TPS.

The annexure-14 indicates the distribution of responsibilities for implementing the various project activities

The others stakeholder are described below

i) The organizations who are purchasing power from the power stations in respect of three power station selected for the Pilot Project, the following are the bulk purchasers of power

Kolgaht TPS	West Bengal Power Development Corp. Ltd. (WBSPDCL)
Faridabad TPS	Haryana Vidhyut Prasaran Nigam Ltd. (HVPNL)
GGSSTP, Ropar	Punjab State Electricity Board (PSEB)

ii) The pollution control board of the respective state who are responsible for controlling the pollution from the various industries including the power station. In respect of three power stations selected for the power project, they are West Begal Pollution Control Board (WBPCB), Haryana Pollution Control Board (HSPCB) and Punjab Pollution Control Board (PPCB).

iii) The electricity regulatory commissions of the respective states who are responsible for approving generation, bulk and retail tariff for the power utilities/SEB In respect of three power stations selected for the power project, they are West Bengal Electricity Regulatory Commission (WBERC), Haryana Electricity Regulatory Commission (HERC) and Punjab Electricity Regulatory Commission (PERC).

iv) Ministry of Power (MOP), GOI. MOP is responsible for policy matter relating to power sector

v) Financial Institution (FIs). The FIs will be providing the fund for replication of the R&M schemes in the other power stations.

vi) National Power Training Institute (NPTI). The training programme for O&M staff is proposed to be conducted through NPTI.

vii) The local public/NGOs.

Information Dissemination and Consultation

For the Pilot Project, the various stakeholders namely concerned Power Utilities/SEB, concerned Power Purchasers. Concerned Pollution Control Boards, Electricity regulatory Commissions for two of the three power stations viz.; WBERC & HERC and NGOs have already been consulted through meetings as well as writing letters. All these stakeholders have supported the project and letters received from them are enclosed in

Annexure-16. PERC has sought certain clarifications in respect of GGSSTP, Ropar, which has been furnished to them and their response is enclosed.

After the successful completion of the pilot project, interactions with the financial institutions, power utilities/SEBs as well as other stackholders will be held by conducting workshops, meetings and through magazines, newspapers etc.

Stakeholder Participation

Covered under above

Social and Participation Issues

Not applicable

2.11 Monitoring & Evaluation Plan

The Power Utilities/SEB will be responsible for implementation of R&M schemes at their respective power stations. The project will be co-executed by CEA as a co-ordinating agency which will be single focal point for GEF /UNDP. CEA will constitute Project Monitoring Cell (PMC) and appoint a senior official as Project Director (PD). Project Director will head the PMC. An R&M cell will be constituted at each of the three power stations to have smooth co-ordination with CEA. PD will monitor the progress of the implementation of R&M schemes in the three identified TPS of the pilot project. The R&M cell at each of the three power stations will submit to PMC the monthly progress reports during implementation of the R&M schemes and monthly power stations operational reports after the completion of the R&M schemes, and based on these reports PMC will prepare a consolidated monthly progress report as well as station operational reports.

PMC will also prepare monthly progress reports on the interaction with the FIs on evolving a financial mechanism as also on the awareness programme for replication of R&M schemes in other power stations. The monthly progress report on the training programme for O&M staff shall also be prepared by the PMC.

CEA, as co-executing agency will be responsible for all dealings with GEF/UNDP to get the allocation of funds as required for the implementation. They will also be responsible for timely distribution of allocated funds to the concerned Power Utilities/SEB and others.

After the implementation of the R&M schemes, the evaluation of performance parameters at the identified three TPS will be carried out by the respective consultants within 6 months of completion of R&M schemes based on the performance test/energy audit report, station power plant operational reports. The respective consultant will prepare the evaluation report at the end of programme for evolving financial mechanism and awareness & training programmes.

After the completion of the project, PMC will prepare an evaluation report on the fulfillment of the objectives of the project.

2.12 Tendering & Procurement Procedure

2.12.1 Introduction

For the present project under GEF programme, a substantial share of the project cost will be utilised to procure technical equipment / machinery / services. In view of the same, the prudent tendering procedures will be followed for this project. A few of the significant features of tendering procedures are as follows-

- International competitive bid
- Consideration of past experience, financial and credibility of the contractor
- Due recognition of availability of state of art technology available with the bidders

These procedures will be similar to guidelines for procurement of goods / services by the World Bank. However, the essence of tendering procedure will be to prepare conducive environment for active participation by the bidders

2.12.2 Procedures

In order to achieve the ultimate objective of procurement of quality product / services following steps will be followed –

a) Preparation of specification for procurement of the goods.

b) Notice Inviting Tenders (NIT) will be published in the leading news-papers as well as in other advertising modes for inviting the Expression of Interest (EoI).

c) To finalize the criteria for evaluation of competence of bidders for undertaking such jobs.

d) To invite the qualified bidders for submitting the techno-commercial and financial bids

e) Finalisation consolidated evaluation criteria for the award of the contract with due weightage to technical offer, compliance by the bidders to stipulated commercial conditions as well as financial offer for the specific assignment.

f) Pre bid conference for clarification to the queries of bidders

g) Public opening of the financial offer

h) Negotiations with the bidder having most techno-commercial competitive offer.

i) Award of contract.

ANNEXURE - 1

ANNEXURE - 1
INCREMENTAL COST ANALYSIS

KOLAGHAT TPS

Total CO2 emission saving per unit of power (APDP - GEF)	Tonne per unit of power	0.0015
Difference of Total NPV per unit of (GEF -APDP)	Rs per unit	-0.0503
Rs per ton of CO2 abatement	Rs per Tonne	-32.50
Pay back period		3.05 years from GEF Implementation
IRR		23.69%

FARIDABAD TPS

Total CO2 emission saving per unit of power (APDP - GEF)	Tonne per unit of power	0.0039
Difference of Total NPV per unit of (GEF -APDP)	Rupees of Unit	-0.4420
Rs per ton of CO2 abatement	Rs per tonne	-112.13
Pay back Period		1.9 Years after GEF Implementation
IRR		36.41%

GGSSTP TPS, Ropar

Total CO2 emission saving per unit of power (APDP - GEF)	Tonne per unit of power	0.0004
Difference of Total NPV per unit of (GEF -APDP)	Rupees per unit	-0.0112
Rs per ton of CO2 abatement	Rs per tonne	-27.18
Pay back Period		3.57 Years from GEF Implementation
IRR		20.00%

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
Kolaghat TPS (Inputs)

INPUTS

Kolaghat		
PLF at present	%	56.3
PLF after APDP	%	61.28
PLF after GEF Project	%	64.35
Loss in PLF during GEF considering implementation of technical schemes at two units per annum	%	8.33
Aux Power Consumption at Present	%	10.19
Aux Power reduction after APDP	%	0.69
Average Aux Power Reduction after GEF Project	%	0.29
Calorific Value	Kcal/Kg	4212
Station HR at prevailing condition	Kcal/Kwhr	3135.0
Station HR reduction after APDP	Kcal/Kwhr	30.0
Station HR reduction after GEF Project	Kcal/Kwhr	309.35
Coal Cost	Rs per tonne	1200
Total Oil Required at present	Kilo Litres	19205
Start up Oil	%	27
Oil for Support for Generation	%	73
Oil Cost	Rs per KiloLitre	15900
Reduction of Start Up Oil by APDP	Kilolitre	0
Reduction of Start Up Oil by GEF Project	Kilolitre	2700
O&M Cost for Maintenance at Present	Million Rs	643.7
O&M Cost for Establishment Constant	Million Rs	326.7
O&M Cost for Maintenance after APDP	Million Rs	579.33
O&M Cost for Maintenance after GEF Project	Million Rs	550.36
APDP Fund Phasing		
1st Year	Million Rs	147
2nd Year	Million Rs	702.8
3rd Year	Million Rs	119.4
GEF Project Fund Phasing	Million Rs	2232
2nd year	Million Rs	744
3 rd Year	Million Rs	744
4thYear	Million Rs	744

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
Kolaghat TPS (Calculations)

Kolaghat Thermal Power Station

Years

Present situation

		Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	PLF	%	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3
2	Generation	MU	6214	6214	6214	6214	6214	6214	6214	6214	6214	6214	6214	6214	6214	6214	6214
3	Aux. Consumption	MU	633	633	633	633	633	633	633	633	633	633	633	633	633	633	633
4	Sent Power	MU	5581	5581	5581	5581	5581	5581	5581	5581	5581	5581	5581	5581	5581	5581	5581
5	Average Calorific Value of coal	Kcal/Kg	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212
6	Station Heat Rate	Kcal/Kwhr	3135	3141	3148	3154	3160	3166	3173	3179	3136	3192	3198	3205	3211	3217	3224
7	Coal Cost	Rs. Per Tonne	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
8	Coal Consumption	Million Tonne	4.63	4.63	4.64	4.65	4.66	4.67	4.68	4.69	4.70	4.71	4.72	4.73	4.74	4.75	4.76
9	Total Coal Cost	Million Rs.	5550	5561	5572	5584	5595	5606	5617	5628	5640	5651	5662	5674	5685	5696	5708
10	Oil Consumption for Start Up	kilo Litres	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185
11	Fuel Oil Cost	Rs. Per Kilolitre	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900
12	Total Oil Cost	Million Rs.	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45
13	O&M Cost for Maintenance	Million Rs.	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7	643.7
14	O&M Cost for Establishment	Million Rs.	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7
15	Annual cost	Million Rs.	6603	6614	6625	6636	6648	6659	6670	6681	6693	6704	6715	6726	6738	6749	6761

Annexure - 1
Kolaghat TPS (Calculations)

Situation After Implementation of R&M Activities under APDP (Baseline)

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	APDP Scheme	Million Rs.	147.00	#####	- #####												
2	PLF	%	56.3	56.3	56.3	61.28	61.28	61.28	61.28	61.28	61.28	61.28	61.28	61.28	61.28	61.28	61.28
3	Generation	MU	6214	6214	6214	6764	6764	6764	6764	6764	6764	6764	6764	6764	6764	6764	6764
4	Aux Consumption	MU	633	633	633	643	643	643	643	643	643	643	643	643	643	643	643
5	Sent Power	MU	5581	5581	5581	6122	6122	6122	6122	6122	6122	6122	6122	6122	6122	6122	6122
6	Average Calorific Value of coal	Kcal/Kg	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212
7	Station Heat Rate	Kcal/Kwhr	3135	3141	3148	3118	3124	3130	3136	3143	3149	3155	3161	3168	3174	3180	3187
8	Coal Cost	Rs. Per tonne	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
9	Coal Consumption	Million Tonne	4.63	4.63	4.64	5.007	5.017	5.03	5.04	5.05	5.06	5.07	5.08	5.09	5.10	5.11	5.12
10	Total Coal Cost	Million Rs.	5550	5561	5572	6008	6020	6032	6044	6056	6068	6080	6092	6105	6117	6129	6141
11	Oil Consumption for Start Up	kilo Litres	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185	5185
12	Cost of Oil	Rs per Kilolitre	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900
13	Total Oil Cost	Million Rs.	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45	82.45
14	O&M Cost for Maintenance	Million Rs.	643.7	643.7	643.7	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33
15	O&M Cost for Establishment	Million Rs.	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7	326.7
16	Annual cost (1+10+13+14+15)	Million Rs.	6750	7317	6745	6996	7008	7020	7032	7045	7057	7069	7081	7093	7105	7118	7130
(a)	Annual cost Per unit of power	Rs per unit	1.209492	1.3111	1.2085	1.1429	1.1449	1.1468	1.1488	1.1508	1.1528	1.1547	1.1567	1.1587	1.1607	1.1627	1.1647
	Sum of NPV After APDP	Rs per unit	8.06														
(b)	**CO_2 Emission**																
	CO_2 Emission	Million Tonnes	7.57	7.59	7.60	8.20	8.21	8.23	8.24	8.26	8.28	8.29	8.31	8.33	8.34	8.36	8.38
c	CO_2 Emission per unit of power	Tonne per unit	0.001357	0.0014	0.0014	0.0013	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014

The APDP R&M activities are to be carried out during normal planned outages for maintenance

Annexure - 1

Kolaghat TPS (Calculations)

Situation After Implementation of R&M Activities under APDP and GEF Project

1 GEF Scheme	Million Rs.		744	744	744											
2 APDP Scheme	Million Rs.	147	702 8	119 4												
3 PLF	%	56.3	47 97	47 97	52 95	64 35	64.35	64 35	64.35	64.35	64.35	64 35	64 35	64 35	64.35	64 35
4 Generation	MU	6214	5294	5294	5844	7102	7102	7102	7102	7102	7102	7102	7102	7102	7102	7102
5 Aux. Consumption	MU	633	539	539	555	654	654	654	654	654	654	654	654	654	654	654
6 Net Power Sent	MU	5581	4755	4755	5289	6448	6448	6448	6448	6448	6448	6448	6448	6448	6448	6448
7 Average Calorific Value of coal	Kcal/Kg	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212	4212
8 Station Heat Rate	Kcal/Kwhr	3135	3141	3148	3118	2808	2814	2819	2825	2831	2836	2842	2848	2853	2859	2865
9 Coal Cost	Rs. Per Tonne	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
10 Coal Consumption	Million Tonnes	4 63	3 95	3 96	4 33	4.74	4 74	4.75	4.76	4 77	4 78	4 79	4 80	4 81	4 82	4 83
11 Total Coal Cost	Million Rs.	5550	4738	4748	5191	5682	5694	5705	5716	5728	5739	5751	5762	5774	5785	5797
12 Oil Consumption for Start Up	kilo Litres	5185	5185	5185	5185	2485	2485	2485	2485	2485	2485	2485	2485	2485	2485	2485
13 Cost of Oil	Rs per Kilolitre	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900	15900
14 Total Oil Cost	Million Rs.	82 45	82 45	82 45	82 45	39 52	39 52	39 52	39 52	39 52	39 52	39 52	39.52	39 52	39.52	39 52
15 O&M Cost for Maintenance	Million Rs.	643 7	643 7	643 7	579 33	550 36	550.36	550 36	550.33	550 36	550 36	550 36	550 36	550 36	550 36	550 36
16 O&M Cost for Establishment	Million Rs.	326.70	326 70	326.70	326 70	326 70	326 70	326 70	326 70	326 70	326 70	326 70	326 70	326.70	326 70	326 70
17 Annual cost (1+11+14+15+16)	Million Rs.	6750	7238	6664	6923	6599	6610	6622	6633	6644	6656	6667	6679	6690	6702	6714
(a) Annual Cost																
Annual cost per Unit of power	Rs per unit	1.2095	1.5222	1.4015	1.309	1 0234	1.0251	1.0269	1.0287	1.0304	1.0322	1.034	1.0358	1.0376	1.0393	1.0411
Total NPV after GEF	Rs per unit	6 01														

The R&M activities under GEF Project are proposed to be carried out while taking additional shut down of three months per unit over the normal planned outage for maintenance of one month at Kolaghat TPS.

It is considered that R&M activities on two units per year will be undertaken at Kolaghat TPS.

Annexure - 1

Kolaghat TPS (Calculations)

(b) CO_2 Emission

CO_2 Emission	Million Tonnes	7.571399	6.4636	6.4765	7.0812	7.7515	7.767	7.7823	7.7981	7.8137	7.8294	7.845	7.8607	7.8764	7.8922	7.908
CO_2 Emission per unit of power	Tonnes / Unit	0.001357	0.0014	0.0014	0.0013	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012
Difference of CO2 emission per unit of power (APDP-GEF)	Tonne per unit of power	0	0	0	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Total CO2 emission saving per unit of power	Tonne per unit of power	0.001549	Average value of reduction of CO2 per unit over next 10 yrs	0.0001
Difference of Total NPV per unit of (GEF -APDP)	Rupees	-0.05033	Reduction in CO2 per annum in MT at same level of generation as of APDP	0.9514
Rs per ton of CO2 abatement	Rs per Tonne	-32.50	Reduction in Coal Consumption in MT at same level of generation as of APDP	0.5812

Estimation of Payback Period IRR for the Investment Under GEF Project

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UNDER APDP																
Coal cost per unit of power	Rs per unit	0.995	0.996	0.998	0.981	0.983	0.985	0.987	0.989	0.991	0.993	0.995	0.997	0.999	1.001	1.003
Oil cost for start up	Million Rs	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447	82.447
Overall Fuel cost	Million Rs	5632.7	5643.8	5654.9	6090.3	6102.3	6114.4	6126.4	6138.5	6150.6	6162.8	6174.9	6187.1	6199.3	6211.6	6223.8
O&M Cost for Maintenance	Million Rs	643.70	643.70	643.70	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33	579.33
O&M Cost for Establishment	Million Rs	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70
APDP Loan	Million Rs	147.00	702.80	119.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Kolaghat TPS (Calculations)

UNDER GEF																
Coal cost per unit of power	Rs per unit	0.99	1.00	1.00	0.98	0.88	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.90	0.90	0.90
Oil Cost for start up	Million Rs	82.45	82.45	82.45	82.45	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52	39.52
Overall Fuel cost	Million Rs	5632.7	4820.6	4830.1	5273.4	5721.8	5733.2	5744.6	5756.0	5767.4	5778.9	5790.4	5801.9	5813.4	5824.9	5836.5
O&M Cost for Maintenance	Million Rs	643.70	643.70	643.70	579.33	550.36	550.36	550.36	550.36	550.36	550.36	550.36	550.36	550.36	550.36	550.36
O&M Cost for Establishment	Million Rs	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70	326.70
Total Investment under GEF	Million Rs	0	744	744	744	0	0	0	0	0	0	0	0	0	0	0
UNDER GEF - APDP																
Saving in Rs due to reduction of coal per Unit	Rs / unit	0.000	0.000	0.000	0.000	0.102	0.102	0.103	0.103	0.103	0.103	0.103	0.104	0.104	0.104	0.104
Overall coal saving at net power output after GEF	Million Rs	0.00	0.00	0.00	0.00	658.86	660.18	661.50	662.83	664.15	665.48	666.81	668.14	669.48	670.82	672.16
Saving in Rs on reduction in Oil consumption	Million Rs	0.00	0.00	0.00	0.00	42.93	42.93	42.93	42.93	42.93	42.93	42.93	42.93	42.93	42.93	42.93
Saving in Rs on reduction in O&M cost for maintenance	Million Rs	0.00	0.00	0.00	0.00	28.97	28.97	28.97	28.97	28.97	28.97	28.97	28.97	28.97	28.97	28.97
Overall saving after GEF ie cash inflow	Million Rs	0.00	0.00	0.00	0.00	730.86	732.18	733.50	734.83	736.15	737.48	738.81	740.14	741.48	742.82	744.16
Cash outflow (Investment under GEF)	Million Rs	0.00	744.00	744.00	744.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash inflow - Cash Outflow	Million Rs	0.00	-744.0	-744.0	-744.0	730.9	732.2	733.5	734.8	736.2	737.5	738.8	740.1	741.5	742.8	744.2
NPV @12% discount	Million Rs	1181.90														
Pay back Period		3.05 years														
IRR		23.7%														

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
Faridabad TPS, Faridabad (INPUTS)

INPUTS

FARIDABAD

PLF at present	%	54.56
PLF after APDP	%	64.50
PLF after GEF Project	%	72.00
Loss in PLF during GEF Project Implementation	%	13.89
Aux Power Consumption at Present	%	13.02
Aux Power reduction after APDP	%	0
Aux Power Reduction after GEF Project	%	0.16
Calurific Value	Kcal/Kg	4519
Station HR at prevailing condition	Kcal/Kwhr	4158.8
Station HR reduction after APDP	Kcal/Kwhr	60.0
Station HR reduction after GEF Project	Kcal/Kwhr	705.74
Coal Cost	Rs per tonne	2200
Total Oil Required at present	Kilo Litres	4210
Start up Oil	%	27
Oil for Support for Generation	%	73
Oil Cost	Rs per KiloLitre	12686
Reduction of Start Up Oil by APDP	Kilolitre	0
Reduction of Start Up Oil by GEF Project	Kilolitre	0
O&M Cost for Maintenance at Present	Million Rs	85.9
O&M Cost for Establishment (Constant)	Million Rs	177.5
O&M Cost for Maintenance after APDP	Million Rs	82.464
O&M Cost for Maintenance after GEF Project	Million Rs	74.22
APDP Fund Phasing		
1st Year	Million Rs	79
2nd Year	Million Rs	79
3rd Year	Million Rs	79
GEF Project Fund Phasing	Million Rs	709
2nd year	Million Rs	237
3 rd Year	Million Rs	236
4thYear	Million Rs	236

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
Faridabad TPS, Faridabad (Calculations)

Faridabad Thermal Power Station

		Units	Years Present situation														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	PLF	%	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56	54.56
2	Generation	MU	789	789	789	789	789	789	789	789	789	789	789	789	789	789	789
3	Aux. Consumption	MU	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
4	Sent Power	MU	686	686	686	686	686	686	686	686	686	686	686	686	686	686	686
5	Average Calorific Value of coal	Kcal/Kg	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519
6	Station Heat Rate	Kcal/Kwhr	4159	4167	4175	4184	4192	4201	4209	4217	4226	4234	4243	4251	4260	4268	4277
7	*Coal Cost*	Rs. Per Tonne	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
8	Coal Consumption	Million Tonne	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.75
9	Total Coal Cost	Million Rs.	1597	1600	1603	1606	1609	1613	1616	1619	1622	1626	1629	1632	1635	1639	1642
10	Oil Consumption for Start Up	kilo Litres	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137
11	Fuel Oil Cost	Rs. Per Kilolitre	12686	12686	12686	12686	12686	12686	12666	12686	12686	12686	12686	12686	12686	12666	12686
12	Total Oil Cost	Million Rs.	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42
13	*O&M Cost for Maintenance*	Million Rs.	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90	85.90
14	O&M Cost for Establishment	Million Rs.	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5
15	Annual cost	Million Rs.	1874	1878	1881	1884	1887	1891	1894	1897	1900	1903	1907	1910	1913	1916	1920

Stabilizing Green House Gases From Indian Power Sector

Annexure - 1

Faridabad TPS, Faridabad (Calculations)

Situation after Implementation of R&M activities under APDP (Baseline)

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Capital Cost (APDP)	Million Rs.	79.00	79.00	79.00												
2	PLF	%	54.56	54.56	54.56	64.50	64.50	54.50	64.50	64.50	64.50	64.50	64.50	64.50	64.50	64.50	64.50
3	Generation	MU	789	789	789	932	932	932	932	932	932	932	932	932	932	932	932
4	Aux.	MU	103	103	103	121	121	121	121	121	121	121	121	121	121	121	121
5	Sent Power	MU	686	686	686	811	811	811	811	811	811	811	811	811	811	811	811
6	Average Calorific Value of coal	Kcal/Kg	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519
7	Station Heat Rate	Kcal/Kw hr	4158.8	4167	4175	4115	4124	4132	4140	4148	4157	4165	4173	4182	4190	4199	4207
8	Coal Cost	Rs. Per tonne	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
9	Coal Consumption	Million Tonne	0.73	0.73	0.73	0.849	0.851	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.87	0.87
10	Total Coal Cost	Million Rs.	1597	1600	1603	1868	1872	1875	1879	1883	1887	1890	1894	1898	1902	1906	1909
11	Oil Consumption for Start Up	kilo Litres	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137
12	Cost of Oil	Rs per Kilolitre	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686
13	Total Oil Cost	Million Rs.	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42
14	O&M Cost for Maintenance	Million Rs.	85.9	85.9	85.9	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464
15	O&M Cost for Establishment	Million Rs.	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5
16	Annual cost (1+10+13+14+15)	Million Rs.	1953	1957	1960	2142	2146	2150	2153	2157	2161	2165	2169	2172	2176	2180	2184
(a)	**Annual cost**																
	Per unit of power	Rs per unit	2.847907	2.8526	2.8572	2.6410	2.6464	2.651	2.6557	2.6603	2.6649	2.6696	2.6743	2.6789	2.6836	2.6883	2.693
	Sum of NPV After APDP	Rs per unit	18.5840														
(b)	**CO_2 Emission**																
	CO_2 Emission	Million Tonnes	1.40	1.41	1.41	1.64	1.65	1.65	1.65	1.66	1.66	1.66	1.67	1.67	1.67	1.68	1.68
c	CO_2 Emission per unit of power	Tonne per unit	0.002048	0.0021	0.0021	0.002	0.002	0.002	0.002	0.002	0.002	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021

The APDP R&M activities are to be carried out during normal planned outages for maintenance

Annexure - 1

Faridabad TPS, Faridabad (Calculations)

Situation after Implementation of R&M activities under APDP and GEF Project

1	Capital Cost (GEF)	Million Rs.		237	236	236											
2	Capital Cost (APDP)	Million Rs.	79	79	79												
3	PLF	%	54.56	40.67	40.67	50.61	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00
4	Generation	MU	789	586	588	732	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041	1041
5	Aux. Consumption	MU	103	77	77	95	134	134	134	134	134	134	134	134	134	134	134
6	Net Power Sent	MU	686	511	511	636	907	907	907	907	907	907	907	907	907	907	907
7	Average Calorific Value of coal	Kcal/Kg	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519
8	Station Heat Rate	Kcal/Kw hr	4158.8	4167	4175	4115	3410	3417	3423	3430	3437	3444	3451	3458	3465	3472	3479
9	Coal Cost	Rs. Per Tonne	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
10	Coal Consumption	Million Tonnes	0.73	0.54	0.54	0.67	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80
11	Total Coal Cost	Million Rs.	1597	1193	1195	1466	1728	1731	1734	1738	1741	1745	1748	1752	1755	1759	1762
12	Oil Consumption for Start Up	kilo Litres	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137
13	Cost of Oil	Rs per Kilolitre	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686
14	Total Oil Cost	Million Rs.	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42
15	O&M Cost for Maintenance	Million Rs.	85.9	85.9	85.9	82.464	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22
16	O&M Cost for Establishment	Million Rs.	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50
17	Annual cost (1+11+14+15+16)	Million Rs.	1953	1786	1788	1976	1994	1997	2001	2004	2008	2011	2014	2018	2021	2025	2029
(a)	**Annual Cost**																
	Annual cost per Unit of power	Rs per unit	2.847907	3.4937	3.4964	3.1056	2.1983	2.2021	2.206	2.2098	2.2136	2.2175	2.2213	2.2252	2.229	2.2329	2.2368
	Total NPV after GEF	Rs per unit	18.1420														

The R&M activities under GEF Project are proposed to be carried out while taking additional shut down of five months per unit over the normal planned outage for maintenance of one month at Faridabad TPS.

It is considered that R&M activities on one unit per year will be undertaken at Faridabad TPS.

Annexure - 1

Faridabad TPS, Faridabad (Calculations)

(b) CO_2 Emission

CO_2 Emission	Million Tonnes	1.40491	1.0494	1.0515	1.2896	1.52	1.5231	1.5261	1.5292	1.5322	1.5353	1.5384	1.5415	1.5445	1.5476	1.5507
CO_2 Emission per unit of power	Tonnes / Unit	0.002048	0.0021	0.0021	0.002	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Difference of CO2 emission per unit of power (APDP-GEF)	Tonne per unit of power	0	0	0	0	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Total CO2 emission saving per unit of power	Tonne per unit of power	0.003942														
Difference of Total NPV per unit of (GEF -	Rs per unit	-0.44198														
Rs per ton of CO2 abatement		-112.13														

Average value of reduction of CO_2 Emission per unit over next 10 yrs	0.0004
Reduction in CO_2 Emission per annum in MT at same level of generation	0.3337
Reduction in Coal Consumption in MT at same level of generation	0.1724

Estimation of Payback Period and IRR for Investment Under GEF

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UNDER APDP																
Coal cost per unit of power	Rs per unit	2.328	2.332	2.337	2.303	2.308	2.313	2.317	2.322	2.327	2.331	2.336	2.341	2.345	2.350	2.355
Oil cost for start up	Million Rs	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420
Overall Fuel cost	Million Rs	1611.1	1614.3	1617.5	1882.3	1886.0	1889.8	1893.5	1897.3	1901.0	1904.8	1908.6	1912.4	1916.2	1920.0	1923.8
O&M Cost for Maintenance	Million Rs	85.90	85.90	85.90	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46
O&M Cost for Establishment	Million Rs	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50
APDP Capital Cost	Million Rs	79.00	79.00	79.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
Faridabad TPS, Faridabad (Calculations)

UNDER GEF																
Coal cost per unit of power	Rs per unit	2.33	2.33	2.34	2.30	1.90	1.91	1.91	1.92	1.92	1.92	1.93	1.93	1.94	1.94	1.94
Oil Cost for start up	Million Rs	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42
Overall Fuel cost	Million Rs	1611.1	1207.0	1209.4	1480.1	1741.9	1745.4	1748.8	1752.3	1755.8	1759.3	1762.8	1766.3	1769.8	1773.3	1776.8
O&M Cost for Maintenance	Million Rs	85.90	85.90	85.90	82.46	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22	74.22
O&M Cost for Establishment	Million Rs	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50
Total Investment under GEF	Million Rs	0	237	236	236	0	0	0	0	0	0	0	0	0	0	0
Saving in Rs due to reduction of coal per Unit	Rs / unit	0.000	0.000	0.000	0.000	0.403	0.404	0.405	0.406	0.406	0.407	0.408	0.409	0.410	0.411	0.411
Overall coal saving at net power output after GEF	Million Rs	0.00	0.00	0.00	0.00	365.64	366.27	367.11	367.84	368.58	369.31	370.05	370.79	371.53	372.28	373.02
Saving in Rs on reduction in Oil consumption	Million Rs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Saving in Rs on reduction in O&M cost for maintenance	Million Rs	0.00	0.00	0.00	0.00	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25
Overall saving after GEF ie cash inflow	Million Rs	0.00	0.00	0.00	0.00	374.29	375.02	375.76	376.49	377.23	377.97	378.71	379.45	380.19	380.93	381.68
Cash outflow (Investment under GEF)	Million Rs	0.00	237.00	236.00	236.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash inflow - Cash Outflow	Million Rs	0.00	-237.0	-236.0	-236.0	374.3	375.0	375.8	376.5	377.2	378.0	378.7	379.4	380.2	380.9	381.7
NPV @12% discount factor	Million Rs	916.32														
Pay back Period		1.9 Years														
IRR		36.41%														

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
GGSSTP, Ropar (INPUTS)

INPUTS

Guru Gobind Singh Super Thermal Power Station, Ropar

PLF at present	%	74.3
PLF after APDP	%	75.0
PLF after GEF Project	%	75.0
Loss in PLF during GEF Project Implementation	%	8.33
Aux Power Consumption at Present	%	8.12
Aux Power reduction after APDP	%	0
Aux Power Reduction after GEF Project	%	0.28
Calorific Value	Kcal/Kg	4160
Station HR at prevailing condition	Kcal/Kwhr	2774.7
Station HR reduction after APDP	Kcal/Kwhr	27.7
Station HR reduction after GEF Project	Kcal/Kwhr	84.34
Coal Cost	Rs per tonne	1980
Total Oil Required at present	Kilo Litres	16605
Start up Oil	%	27
Oil for Support for Generation	%	73
Oil Cost	Rs per KiloLitre	7538.83
Reduction of Start Up Oil by APDP	Kilolitre	0
Reduction of Start Up Oil by GEF Project	Kilolitre	2700
O&M Cost for Maintenance at Present	Million Rs	289.1
O&M Cost for Establishment (Constant)	Million Rs	469
O&M Cost for Maintenance after APDP	Million Rs	260.19
O&M Cost for Maintenance after GEF Project	Million Rs	247.18
APDP Fund Phasing		
2nd Year	Million Rs	167
3rd Year	Million Rs	168
4th Year	Million Rs	168
GEF Project Fund Phasing	Million Rs	1400
2nd year	Million Rs	467
3 rd Year	Million Rs	467
4thYear	Million Rs	466

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
GGSSTP TPS, Ropar (Calculations)

Guru Gobind Singh Super Thermal Power Station, Ropar

		Units	Years														
			Present situation														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	PLF	%	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32	74.32
2	Generation	MU	8203	8203	8203	8203	8203	8203	8203	8203	8203	8203	8203	8203	8203	8203	8203
3	Aux. Consumption	MU	666	666	666	666	666	666	666	666	666	666	666	666	666	666	666
4	Sent Power	MU	7537	7537	7537	7537	7537	7537	7537	7537	7537	7537	7537	7537	7537	7537	7537
5	Average Calorific Value of coal	Kcal/Kg	4180	4160	4160	4160	4160	4160	4130	4160	4160	4160	4160	4160	4160	4160	4160
6	Station Heat Rate	Kcal/Kwhr	2775	2780	2786	2791	2797	2803	2808	2814	2819	2825	2831	2836	2842	2848	2853
7	Coal Cost	Rs. Per Tonne	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
8	Coal Consumption	Million Tonne	5.47	5.48	5.49	5.50	5.52	5.53	5.54	5.55	5.56	5.57	5.58	5.59	5.60	5.62	5.63
9	Total Coal Cost	Million Rs.	10833	10855	10877	10898	10920	10942	10964	10986	11008	11030	11052	11074	11096	11118	11141
10	Oil Consumption for Start Up	kilo Litres	4483	4483	4483	4483	4483	4483	4483	4483	4483	4483	4483	4483	4483	4483	4483
11	Fuel Oil Cost	Rs. Per Kilolitre	7539	7539	7539	7539	7539	7539	7539	7539	7533	7539	7539	7539	7539	7539	7539
12	Total Oil Cost	Million Rs.	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80	33.80
13	O&M Cost for Maintenance	Million Rs.	289.10	#####	#####	289.10	289.10	289.10	289.10	289.10	289.10	289.10	289.10	289.10	289.10	289.10	289.10
14	O&M Cost for Establishment	Million Rs.	469.00	#####	#####	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00
15	Annual cost	Million Rs.	11625	11647	11669	11690	11712	11734	11756	11778	11800	11822	11844	11866	11888	11910	11933

2.1 Introduction

Electricity is vital input to all form of economic activity, be it agricultural, industrial, transport and commercial. During the last five decades since independence, there has been tremendous growth in electricity generation in India. The installed capacity has grown over 74 folds since independence leading to growth in energy generation of over 120 times in the corresponding period.

Electricity generation has come to be increasingly dependent on thermal power stations. Both hydro and nuclear have not kept pace with the plans due to various reasons. Thermal power sector presently accounts for about 71% of the total installed capacity in the country and in the year 2000-2001 over 81% of the country's total electricity generation has come from thermal stations.

2.2 Present Situation of Electricity Sector in India

2.2.1 Salient Features at A Glance

Present Installed Capacity of India as on 31.07.2001 was as below:

Thermal	-	72634.17 MW
Hydro	-	25289.53 MW
Nuclear	-	2860.00 MW
Wind	-	1339.96 MW
Total	-	102123.66 MW

Energy Shortage	-	6.9%
Peak Demand Shortage	-	12.5%

2.2.2 Other Parameters At a Glance

Plant Load Factor (1999-2000) (For Thermal Power Stations)	-	67.3%
Coal Consumed (1999-2000) (In Power Sector)	-	220.74 Million Tonnes

Stabilizing Green House Gases From Indian Power Sector

Annexure - 1

GGSSTP TPS, Ropar (Calculations)

Situation After Implementation of R&M Activities under APDP and GEF Project

1 GEF Scheme	Million Rs.		467	467	466											
2 APDP Scheme	Million Rs.		167	168	168											
3 PLF	%	74.32	65 99	65 99	65 99	75 00	75.00	75.00	75 00	75 00	75 00	75 00	75 00	75 00	75 00	75 00
4 Generation	MU	8203	7283	7283	7283	8278	8278	8278	8278	8278	8278	8278	8278	8278	8278	8278
5 Aux. Consumption	MU	666	591	591	591	649	649	649	649	649	649	649	649	649	649	649
6 Net Power Sent	MU	7537	6692	6692	6692	7629	7629	7629	7629	7629	7629	7629	7629	7629	7629	7629
7 Average Calorific Value of coal	Kcal/Kg	4160	4160	4160	4160	4160	4160	4160	4160	4160	4160	4160	4160	4160	4160	4160
8 Station Heat Rate	Kcal/Kwhr	2774.67	2780	2786	2791	2679	2685	2690	2695	2701	2706	2712	2717	2722	2728	2733
9 Coal Cost	Rs. Per Tonne	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
10 Coal Consumption	Million Tonnes	5 47	4 87	4.8773	4.8671	5 33	5 34	5 35	5 36	5 37	5 39	5 40	5.41	5.42	5 43	5 44
11 Total Coal Cost	Million Rs.	10833	9638	9657	9676	10557	10578	10599	10620	10641	10663	10684	10705	10727	10748	10770
12 Oil Consumption for Start Up	kilo Litres	4483	4483	4483	4483	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783
13 Cost of Oil	Rs per Kilolitre	7538.83	7538.8	7538.8	7538.83	7538 83	7538.83	7538 83	7538.83	7538.83	7538 83	7538 83	7538.83	7538.83	7538 83	7538 83
14 Total Oil Cost	Million Rs.	33.80	33 80	33 80	33 80	13 44	13 44	13 44	13 44	13 44	13 44	13 44	13 44	13.44	13 44	13 44
15 O&M Cost for Maintenance	Million Rs.	289.1	289.1	289 1	289.1	247 18	247.18	247.18	247.18	247.18	247.18	247 18	247.18	247.18	247 18	247 18
16 O&M Cost for Establishment	Million Rs.	469.00	469.00	469 00	469 00	469 00	469 00	469 00	469 00	469 00	469 00	469 00	469 00	469.00	469.00	469 00
17 Annual cost (1+11+14+15+16)	Million Rs.	11625	11064	11084	11102	11286	11307	11328	11350	11371	11392	11414	11435	11456	11478	11499
(a) **Annual Cost**																
Annual cost per Unit of power	Rs per unit	1.542415	1.6533	1.6563	1.659068	1.47933	1.4821	1.48487	1.48765	1.49044	1.49322	1.49602	1.49882	1.50163	1.50444	1 50726
Total NPV after GEF	Rs per unit	10.55														

The R&M activities under GEF Project are proposed to be carried out while taking additional shut down of three months per unit over the normal planned outage for maintenance of one month at GGSTP TPS.

It is considered that R&M activities on two units per year will be undertaken at GGSSTP TPS.

Table 2.2 Status of Various Unit Sizes in the Country as on 31.03.2001

Unit Sizes (MW)	**Number of Units**	**Total Capacity (MW)**	**% of Total Thermal Capacity**
30	19	524	0.73
32,35,.40	9	334	0.46
50	19	850	1.18
55, 57.5, 58	6	291	0.40
60	25	1,485	2.07
62.5	10	625	0.87
63.5,67.5,68,70, 75,77	14	960	1.34
82.5	4	320	0.45
100	11	1,047	1.46
105	3	315	0.44
110	37	4,040	5.62
120	21	2,500	3.48
125,130, 150	11	1,750	2.43
200	23	4,600	6.40
210	128	26,880	37.38
250	6	1,500	2.09
500	23	11,500	15.99

2.3.2 Technology Development of Coal Fired Thermal Power Station

Barring a few units installed in early 50s having stoker fired boilers, all coal fired units in the country use pulverised coal firing technology. However, there have been improvements in the design of auxiliary equipment / systems like mills, fans, air pre heaters, burners and firing system to evolve reliable operation with low quality Indian coals. Indirect firing was adopted for some smaller size of units of upto 110 MW. However, all units of 200 MW and above adopt direct firing. Tower type boiler design was introduced on experimental basis for overcoming ash erosion and tube failure problems. These designs have become popular with some utilities and six numbers of tower type boilers are operational at Vijaywada and two at Raichur TPS of KPCL.

Annexure - 1
GGSSTP TPS, Ropar (Calculations)

UNDER GEF																
Coal cost per unit of power	Rs per unit	1.44	1.44	1.44	1.446	1.38	1.39	1.39	1.39	1.39	1.40	1.40	1.40	1.41	1.41	1.41
Oil Cost for start up	Million Rs	33.80	33.80	33.80	33.80	13.44	13.44	13.44	13.44	13.44	13.44	13.44	13.44	13.44	13.44	13.44
Overall Fuel cost	Million Rs	10867.2	9671.7	9690.9	9710.3	10570.0	10591.2	10612.3	10633.5	10654.7	10676.0	10697.4	10718.7	10740.1	10761.6	10783.1
O&M Cost for Maintenance	Million Rs	289.10	289.10	289.10	289.10	247.18	247.18	247.18	247.18	247.18	247.18	247.18	247.18	247.18	247.18	247.18
O&M Cost for Establishment	Million Rs	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00	469.00
Total Investment under GEF	Million Rs	0	467	467	466	0	0	0	0	0	0	0	0	0	0	0
APDP - GEF																
Saving in Rs due to reduction of coal per Unit	Rs / unit	0.000	0.000	0.000	0.000	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.048	0.048	0.048
Overall coal saving at net power output after GEF	Million Rs	0.00	0.00	0.00	0.00	353.86	357.57	358.29	359.01	359.72	360.44	361.16	361.89	362.61	363.34	364.06
Saving in Rs on reduction in Oil consumption	Million Rs	0.00	0.00	0.00	0.00	20.35	20.35	20.35	20.35	20.35	20.35	20.35	20.35	20.35	20.35	20.35
Saving in Rs on reduction in O&M cost for maintenance	Million Rs	0.00	0.00	0.00	0.00	13.01	13.01	13.01	13.01	13.01	13.01	13.01	13.01	13.01	13.01	13.01
Overall saving after GEF ie cash inflow	Million Rs	0.000	0.000	0.000	0.000	390.27	390.98	391.70	392.42	393.13	393.85	394.58	395.30	396.02	396.75	397.47
Cash outflow (Investment under GEF)	Million Rs	0.00	467.00	467.00	466.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash inflow - Cash Outflow	Million Rs	0.00	-467.0	-467.0	-466.0	390.3	391.0	391.7	392.4	393.1	393.9	394.6	395.3	396.0	396.7	397.5
NPV @12%	Million Rs	482.40														
Pay back Period		3.57 Years														
IRR		20.00%														

ANNEXURE - 2

Stabilizing Green House Gases From Indian Power Sector
Annexure - 1
Faridabad TPS, Faridabad (Calculations)

Situation after Implementation of R&M activities under APDP (Baseline)

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Capital Cost (APDP)	Million Rs.	79.00	79.00	79.00												
2	PLF	%	54.56	54.56	54.56	64.50	64.50	54.50	64.50	64.50	64.50	64.50	64.50	64.50	64.50	64.50	64.50
3	Generation	MU	789	789	789	932	932	932	932	932	932	932	932	932	932	932	932
4	Aux	MU	103	103	103	121	121	121	121	121	121	121	121	121	121	121	121
5	Sent Power	MU	686	686	686	811	811	811	811	811	811	811	811	811	811	811	811
6	Average Calorific Value of coal	Kcal/Kg	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519	4519
7	Station Heat Rate	Kcal/Kwhr	4158.8	4167	4175	4115	4124	4132	4140	4148	4157	4165	4173	4182	4190	4199	4207
8	Coal Cost	Rs. Per tonne	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
9	Coal Consumption	Million Tonne	0.73	0.73	0.73	0.849	0.851	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.87	0.87
10	Total Coal Cost	Million Rs.	1597	1600	1603	1868	1872	1875	1879	1883	1887	1890	1894	1898	1902	1906	1909
11	Oil Consumption for Start Up	kilo Litres	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137	1137
12	Cost of Oil	Rs per Kilolitre	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686	12686
13	Total Oil Cost	Million Rs.	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42
14	O&M Cost for Maintenance	Million Rs.	85.9	85.9	85.9	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464	82.464
15	O&M Cost for Establishment	Million Rs.	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5	177.5
16	Annual cost (1+10+13+14+15)	Million Rs.	1953	1957	1960	2142	2146	2150	2153	2157	2161	2165	2169	2172	2176	2180	2184
(a)	**Annual cost**																
	Per unit of power	Rs per unit	2.847907	2.8526	2.8572	2.6410	2.6464	2.651	2.6557	2.6603	2.6649	2.6656	2.6743	2.6789	2.6836	2.6883	2.693
	Sum of NPV After APDP	Rs per unit	18.5840														
(b)	**CO_2 Emission**																
	CO_2 Emission	Million Tonnes	1.40	1.41	1.41	1.64	1.65	1.65	1.65	1.66	1.66	1.66	1.67	1.67	1.67	1.68	1.68
(c)	CO_2 Emission per unit of power	Tonne per unit	0.002048	0.0021	0.0021	0.002	0.002	0.002	0.002	0.002	0.002	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021

The APDP R&M activities are to be carried out during normal planned outages for maintenance

BRIEF DETAILS ON PRESENT ELECTRICITY SECANRIO, ELECTRICITY DEVELOPMENT & FUTURE PROJECTION IN INDIA

TABLE OF CONTENTS

2.1 INTRODUCTION 2
2.2 PRESENT SITUATION OF ELECTRICITY SECTOR IN INDIA 2
  2.2.1 Salient Features at A Glance 2
  2.2.2 Other Parameters At a Glance 2
2.3 DEVELOPMENT OF THERMAL POWER STATION 3
  2.3.1 Coal Fired Thermal Power Station 3
  2.3.2 Technology Development of Coal Fired Thermal Power Station 4
2.4 PLF GROWTH IN LAST DECADE 5
2.5 FUTURE PROJECTION OF ELECTRICITY IN INDIA 6

Annexure - 1

Faridabad TPS, Faridabad (Calculations)

(b) CO_2 Emission

CO_2 Emission	Million Tonnes	1.40491	1.0494	1.0515	1.2896	1.52	1.5231	1.5261	1.5292	1.5322	1.5353	1.5384	1.5415	1.5445	1.5476	1.5507
CO_2 Emission per unit of power	Tonnes / Unit	0.002048	0.0021	0.0021	0.002	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Difference of CO2 emission per unit of power (APDP-GEF)	Tonne per unit of power	0	0	0	0	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Total CO2 emission saving per unit of power	Tonne per unit of power	0.003942														
Difference of Total NPV per unit of (GEF -	Rs per unit	-0.44198														
Rs per ton of CO2 abatement		-112.13														

Average value of reduction of CO2 Emission per unit over next 10 yrs	0.0004
Reduction in CO_2 Emission per annum in MT at same level of generation	0.3337
Reduction in Coal Consumption in MT at same level of generation	0.1724

Estimation of Payback Period and IRR for Investment Under GEF

UNDER APDP		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Coal cost per unit of power	Rs per unit	2.328	2.332	2.337	2.303	2.308	2.313	2.317	2.322	2.327	2.331	2.336	2.341	2.345	2.350	2.355
Oil cost for start up	Million Rs	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420	14.420
Overall Fuel cost	Million Rs	1611.1	1614.3	1617.5	1882.3	1886.0	1889.8	1893.5	1897.3	1901.0	1904.8	1908.6	1912.4	1916.2	1920.0	1923.8
O&M Cost for Maintenance	Million Rs	85.90	85.90	85.90	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46	82.46
O&M Cost for Establishment	Million Rs	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50	177.50
APDP Capital Cost	Million Rs	79.00	79.00	79.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Plant Load Factor (2000-01) (For Thermal Power Stations)	-	69.0%
Coal Consumed (2001-02) (In Power Sector)	-	248 Million Tonnes (Projected based on consumption in 1999-2000)

2.3 Development of Thermal Power Sector in India.

2.3.1 Coal Fired Thermal Power Stations.

As mentioned in clause 2.2.2, coal based thermal power stations have substantial share of the total installed capacity in the country. Table 2.1 represents the technical (operating) parameters vis-à-vis unit size. The number of various capacity coal based thermal power units installed in the country are presented in tabular form under Table 2.2.

Table 2.1 Unit Sizes and Parameters

Unit Size	Commonly Adopted Parameters of Steam
10 MW -30MW	42.22 Kg/cm^2, 455^{0}C
30 MW - 50 MW	60 Kg/ cm^2 ,482^{0}C
50 MW - 60 MW	88 Kg/cm^2, 510^{0}C 90 Kg/cm^2, 535^{0}C
60 MW -100 MW	90 Kg/cm^2, 535^{0}C 102 Kg/cm^2, 535^{0}C
Reheat Units	
80 MW - 100 MW	102 Kg/cm^2, 535^{0}C / 535^{0}C
110 MW- 250 MW	127 Kg/cm^2, 535^{0}C / 535^{0}C 130 Kg/cm^2, 535^{0}C / 535^{0}C 150 Kg/cm^2, 535^{0}C / 535^{0}C
500 MW	168.8 Kg/cm^2, 538^{0}C / 538^{0}C 170 Kg/cm^2, 535^{0}C / 565^{0}C

Two units of once through sub-critical units of tower type design were installed at Talcher STPS of NTPC, Talcher with a view to gain hands on experience of once through technology. These are operating satisfactorily.

While most of the 500 MW units have been built indigenously, few of 500MW units are also outsourced from other countries. Technology advancements are constantly being made by the indigenous manufacturers. Advanced technology with improved profile of more efficient blading for 500 MW LP turbine module is being implemented at few of the 500 MW units in the country.

Thermal power station units of 660 MW having super critical parameters have been cleared by the Government for installation by NTPC. Fluidised bed combustion technology is available for firing high ash & sulphur coals or coal washery rejects and a few of IPPs, Utilities and captive power producers have gone adopting this technology for relatively small units of 30 – 125 MW capacity.

With the vast capacity addition programme for the next ten years, it will become desirable to add higher unit sizes (700-900 MW) to achieve the addition in shortest possible time. Further, adoption of supercritical parameters would also become essential to keep the emission of green house gases under control.

2.4 PLF Growth in Last Decade

Table 2.3 represents the improvement of PLF from 53.9% at the beginning of the last decade to 69% at the end in thermal power stations.

Table 2.3 Thermal Stations PLF for Last Decade

Year	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99.	99-00	00-01
PLF %	53.9	55.3	57.1	61.0	60.0	63.0	64.4	64.7	64.6	67.3	69.0

2.5 Future Projection of Electricity In India

The 16th Electric Power Survey (EPS) covering year wise projections concluded that an addition of 1,03,000 MW would be required during the decade beyond 9th Plan i.e. during(2002 – 2012). The break up of capacity addition projections based on mode of generation is given in Table – 2.4.

Table 2.4 Generation Mode for Project Capacity

Type	**Installed Capacity by 9th Plan End**	**Capacity Addition During**		**Installed Capacity by 11th Plan End in MW**
		10th Plan (2002 – 07)	**11th Plan (2007 – 12)**	
Hydro	26,246.2	17,311	17,962	61,521.2
Thermal	74,754.8	28,328	39,903	142,985.8
Nuclear	3,105	1,300	3,195	7,600
Wind	900	-	-	900
Total	105,008	46,939	61,060	213,007

Out of total capacity addition envisaged for 10th and 11th plan, about 65% is to come from thermal power schemes. About 30% of the total thermal power schemes are in central sector, about 12% in state sector and balance 58% in the private sector.

As at present, Coal / Lignite (fossil fuels) will be dominant fuel for thermal power projects envisaged for benefits during 10th & 11th plans. The capacity being envisaged in 10th & 11th plans based on use of coal / lignite is 52,349 MW, which is about 78% of the total thermal capacity addition.

ANNEXURE - 3

BRIEF DETAILS ON R&M PROGRAMME FOR TPS UNDERTAKEN IN INDIA

Table of contents

3.1 RENOVATION AND MODERNISATION 2

3.1.1 Renovation and Modernisation (R&M) Phase - 1 2

3.1.2 Renovation and Modernisation (R&M) Phase - II 3

3.1.3 Accelerated Power Development Programme (APDP) 4

3.2 NATIONAL PERSPECTIVE PLAN FOR R&M AND LEP OF TPS 5

3.1 Renovation and Modernisation

Renovation and Modernisation (R&M) and Life Extension (LE) of the existing old power stations has been recognised as one of the most cost effective options to achieve additional generation from existing units at low cost and short gestation period in India. This is primarily undertaken to meet the steep rise in the demand of electricity. In addition to generation improvement, which is the primary objective of these schemes / programmes undertaken, other benefits achieved from R&M are

- Limited Improvement in Environmental Emission
- Limited Improvement of Efficiency
- Substantial Improvement in Availability, Safety and Reliability

The various R&M programmes undertaken since 1984 are as follows:

3.1.1 Renovation and Modernisation (R&M) Phase - 1

Government of India (GoI) recognised the importance of R&M way back in 1984 and a centrally sponsored programme called as 'Phase – 1 R&M programme' was launched in 1984 for renovation and modernisation of 34 nos. of thermal power stations covering 163 nos. of thermal units in the country. GoI sanctioned a Central Loan Assistance (CLA) of Rs. 5000 Millions for the programme. The programme was successfully completed in the year 1992 and an additional generation of about 10,000 MU / annum was achieved against a target of 7,000 MU / annum. An amount of Rs. 10660 Millions was incurred on the programme comprising of Rs. 4020 Millions as CLA and Rs. 6640 Millions under State Plan.

Out of total expenditure incurred, the percentage break up on different activities is given in Table – 3.1

Table 3.1 Expenditure in Different Areas in R&M Phase - 1

Area	**% Expenditure**
General Improvement	18%
Environment Improvement	47%
Efficiency Improvement	3%
Safety & Reliability	1%
Availability Improvement	31%

3.1.2 Renovation and Modernisation (R&M) Phase - II

The phase – II R&M programme for 44 Nos. of thermal power stations was taken up in year 1990 – 91. As no central loan assistance (CLA) was provided by GoI for this programme, the Power Finance Corporation (PFC) was assigned to provide loan assistance to State Electricity Boards (SEBs) for R&M works. However, this programme could not progress as per schedule mainly due to non-availability of timely loans from PFC and weak financial condition of SEBs.

By the end of Eighth Plan (March 1997) only about 50% of the works could be completed on all India basis. After partial completion of these works an additional generation of 5000 MU per annum was achieved. Also, Life Extension works on 4 units of Neyveli TPS of total 300 MW capacity were completed. An amount of Rs. 8620 Millions was incurred during eighth plan. CEA reviewed the phase – II R&M programme and balance activities still required to be carried out were included in the ninth plan R&M programme (i.e. next phase).

Out of total expenditure incurred on R&M phase – II programme the percentage break up on different activities given in Table – 3.2

Table 3.2 Expenditure in Different Areas in R&M Phase - II

Area	**% Expenditure**
General Improvement	10%
Life Extension	23%
Environment Improvement	30%
Efficiency Improvement	6%
Safety & Reliability	2%
Availability Improvement	29%

There were no shortfalls in achievement targeted from R&M phase- I programme. However, due to shortage of funds with most of the SEBs, only partial works could be completed under Phase – II programme.

3.1.3 Accelerated Power Development Programme (APDP)

The GoI has approved a new scheme called APDP. Under APDP, funds in the form of grant and loan are being provided to strengthen the existing power system including R&M of thermal power stations. During year 2000 – 2001, an amount of Rs. 10 billion (US$ 208 Million) was sanctioned as additional central plan assistance. During the year 2001 – 2002 an amount of Rs. 15 billion (US $ 31.25 Million) is proposed to be provided under APDP. This scheme will continue till the end of 11th Plan ie. 2012. However, major share of these funds will be earmarked for improvement of Transmission &Distribution.

Under APDP, the entire cost will be met in the form of grant to the order of 90% and balance 10% as loan for special category states (Jammu & Kashmir, Himachal Pradesh, constituent states of North Eastern Region including Sikkim). In case of states not covered under special category, 50% of project cost will be met from APDP out of which half will be in the form of the grant and half in the form of the loan. The utility from their internal resources or loan from PFC (Power Finance Corporation Limited)/REC (rural Electrification Corporation Limited) /FIs (Financial institutions) /Supplier's Credit would meet the remaining 50% of the cost of the project. The PFC is providing loans for R&M at concessional interest rate under their AG&SP. Since the funds for R&M of TPS under AG&SP are limited, it may not be possible to take up all activities under this scheme.

3.2 National Perspective Plan For R&M and LEP of TPS

CEA has formulated a National Perspective Plan for R&M and LE of TPS till the end of 11th Plan (2012). In this Plan, R&M requirement of TPS in the country has been worked out. The Plan also has identified the Power Plants, which will become due for LEP during the next 10 years. As it is evident from the Table – 3.3, huge investment is required for the purpose.

This plan has been prepared on the assumptions that units, which have run over 10 years become eligible for being covered under R&M scheme and plants which have run for more than 20 years or hundred thousand running hours have been considered for RLA studies. Units, which are more than 25 years old, become due for LEP. it has further being assumed that the units will be brought back to their rated capacity and that the rated capacity would be available for another 15-20 years after completion of LE works.

Table 3.3 Perspective Plan At a Glance

SN	**Particulars**	**9th Plan (1997-02)**			**10th Plan (2002-07)**			**11th Plan (2007 – 12)**		
		R&M	**LEP**	**Total**	**R&M**	**LEP**	**Total**	**R&M**	**LEP**	**Total**
1	No. of stations			56			50			38
2	No. of units covered	191	42	233	68	107	175	75	44	119
3	Capacity Covered MW Derated	25856	3091	28947	17310	11022	28332	20140	7860	28000
4	Funds Requirement in Rs.in Millions	23725	27214	50939	19030	74975	94005	24940	49080	74020
5	**Benefits**									
A	R&M Works									
i	Additional Generation MU per year	11000		11000	4250		4250	4850		4850

Stabilizing Green House Gas (GHG) emissions from Indian Power Sector

SN	Particulars	9th Plan (1997-02)			10th Plan (2002-07)			11th Plan (2007 – 12)		
		R&M	LEP	Total	R&M	LEP	Total	R&M	LEP	Total
Ii	Equivalent Capacity at 75% PLF (MW)	1675		1675	650		650	740		740
B	LEP Study									
	Capacity available after LE Works (MW)		3269.5	3269.5		11292	11292		7910	7910

Total Funds requirement during 9th, 10th and 11th plans: Rs. 218.96 Billions

ANNEXURE - 4

BRIEF DETAILS ON ENVIRONMENT ASPECTS RELATED TO TPS IN INDIA

Table of contents

4.1 INTRODUCTION 2
4.2 VARIOUS ACTS EXISTING IN INDIA 2
4.2.1 Water Prevention and Control of Pollution Act,1974. 2
4.2.2 Water Prevention and Control of Pollution Cess Act,1977 2
4.2.3 Air (Prevention and Control of Pollution) Act, 1981 3
4.2.4 Environment (Protection) Act 1986 3
4.3 OPTIONS FOR ENVIRONMENT IMPROVEMENT 4
4.3.1 Efficiency Improvement 4
4.3.2 Technology Upgradation 5
4.3.3 Energy Conservation 5
4.3.4 Energy Pricing 5
4.3.5 Coal Washing / Benefaction 5
4.4 ASH GENERATION SCENARIO 5

4.1 Introduction

Indian power sector is dominated by coal fired thermal power plants. Over 70% of the installed capacity is based on fossil fuels which releases a number of pollutants like particulate matter, ash, carbon dioxide, sulphur oxides (SO_x), nitrogen oxides (NO_x) and heavy metals etc.

Air pollution is caused by solid and gaseous pollutants. Among the solid pollutants dust, fumes, mist and spray are the major pollutants from thermal stations.

Among the gaseous pollutant, carbon monoxide, hydrocarbon, hydrogen sulphide, sulphur oxides and nitrogen oxides are of significance. Carbon di oxide is also significant due to its impact on global warming.

4.2 Various Acts Existing in India

4.2.1 Water Prevention and Control of Pollution Act,1974

This act provides for establishment of central and state boards for prevention of water pollution. The main function of these boards include :

- Preparation of comprehensive programmes
- Collection and dissemination of information
- Training of persons
- Inspection of sewage and trade effluents & plants
- Laying down effluents standards
- Evolution of efficient disposal of sewage and trade effluents

4.2.2 Water Prevention and Control of Pollution Cess Act,1977

This act provides for levying and collection of cess on water consumed by persons carrying on certain industries with a view to augment resources of central and state boards.

4.2.3 Air (Prevention and Control of Pollution) Act, 1981

In India, first Air (Prevention and Control of Pollution) Act was enacted in 1981 with amendments in 1987 for prevention, control and abatement of air pollution. It came into force with effect from May' 1981. The act provides for Central and State Boards with such power and functions as necessary to provide and control the quality of Air. National ambient air quality standards by Central Pollution Control Board (CPCB) have been issued vide notification of April'1994. For wider dispersal of SO_2, stack heights of different capacity units have been stipulated. For units sizes between 200/ 210 MW to less than 500 MW, the stack height has been stipulated as 220 meters. Whereas for 500 MW and higher size units, the stack height is 275 meters.

4.2.4 Environment (Protection) Act 1986

Environment (Protection) Act (EPA) 1986 came into force w.e.f. 19.11.86 and provides for protection, improvement of environment and for matters connected therewith. It empowers the Central Government to take all such measures as deemed necessary for protecting and meeting the quality of environment and preventing, controlling and abating environmental pollution. Standards for liquid effluents have been issued under EPA notification dated 19.11.1986.

MoE&F vide Gazette notification of 19th May'1993 issued amendment rules to Environment (Protection) Act, 1986. In addition to other limits, these rules stipulated the particulate matter emission limits for thermal power stations. The same is mentioned in Table 4.1

Table 4.1 Particulate Matter Emission Limits for Thermal Power Stations

SN	Parameter	Emission Limit
1	Generation Capacity 62.5 MW or more	150 mg/Nm^3
2	Generation Capacity less than and 62.5 MW and plants commissioned prior 01.01.1982	350 mg/Nm^3
3	Units located in the protected area irrespective of generation capacity	150 mg/Nm^3

As per CPCB notification dated 11.04.94, Ambient Air Quality (A.A.Q) Standards have been prescribed for sulphur oxides, nitrogen oxides, suspended particulate respirable matter, lead and carbon monoxide separately for industrial area, residential / rural and sensitive area respectively. A.A.Q on 24 hourly average permissible concentrations are given in Table 4.2.

Table 4.2 A.A.Q on 24 Hourly Average, Permissible Concentration

Pollutants	**Industrial Area** ug/m³	**Residential Area** ug/m³	**Sensitive Area** ug/m³
SO_2	120	80	30
NO_2	120	80	30
SPM	500	200	100
RPM	150	100	75
Lead	1.5	1.00 mg/m³	0.75
Carbon monoxide	10.0 mg/m³	4.00 mg/m³	2.00 mg/m³

As per the Gazette notification 19th September'1997 as amended vide notification dated 30th June'1998, certain specified power plants are required to use coal with ash content less than 34%. The date of implementation of this notification has since been revised to 1st June'2002.

As per another Gazette notification 14th September'1999, all power stations shall submit the action plan for full utilisation of fly ash by the end of ninth year.

4.3 Options for Environment Improvement

4.3.1 Efficiency Improvement

The scope and need of energy efficiency is much higher due to the fact that a large number of power plants installed in the country have grown old and are inefficient as compared to present day equipment due to advancement of technology with the time.

4.3.2 Technology Upgradation

Technology upgradation is most effective and most popularly known method of producing the same goods with lower energy consumption.

4.3.3 Energy Conservation

As the environmental pollution is proportional to the amount of energy used, it is obvious that pollution could be arrested by minimising the consumption of energy.

4.3.4 Energy Pricing

Energy pricing plays a crucial role in stimulating the end-use efficiency of power. It is futile to expect substantial improvement in energy efficiency, if tariff is kept artificially below real cost of generation.

4.3.5 Coal Washing / Benefaction

A number of studies have been conducted in the past to quantify the economics of using beneficated coal in Indian power stations. These studies have indicated in quantitative terms the benefits of using washed coal both in terms of O&M as well as capital cost of project. Vide MoE&F Notification dated 19th September'1997 as amended till date, certain categories of thermal plants are required to use coal containing ash not more than 34% by June'2002. These plants include the thermal plants located beyond 1000 Km from pitheads. These plants also include thermal plant located in urban area or sensitive areas. Implementation of this Notification is expected to give fillip to setting up of coal washeries in the country.

4.4 Ash Generation Scenario

There has been an increase in ash generation steadily with the increase in capacity of power generation. The quantum has increased from 69 million tonnes in 1995-96 to 79 million tonnes during 1998-99. The ash generation is likely to touch 95 million tonnes (including captive thermal power plants) during the current year (2001-02). With the anticipated increase in the power generation and continued dependence on coal based power generation, the ash generation is expected to go upto about 170 million tonnes by the end of 2012. This large quantum of ash generation needs a dedicated effort to identify measures to reduce fly ash production and also to augment measures for faster utilisation.

Many initiatives have been taken to overcome the problem by utilising the ash for meaningful purposes like brick making ,ccncrete blocks etc.

ANNEXURE - 5

OTHER INITIATIVES BY GoI

Table of contents

5.1 INTRODUCTION 2

5.2 R&M / LEP OF POWER STATIONS 2

5.3 REFORMS & RESTRUCTURING OF POWER SECTOR IN INDIA 2

- 5.3.1 Transmission & Distribution Losses 2
- 5.3.2 Reform Process in Power Sector 3

5.4 STRENGTHENING OF TRANSMISSION AND DISTRIBUTION SYSTEM 6

5.5 ENVIRONMENTAL ASPECTS RELATED TO POWER SECTOR IN INDIA .. 7

5.1 Introduction

GoI has taken up many initiatives in order to strengthen the existing power sector for efficient, reliable and quality operation in all associated facets. These initiatives include primarily the following:

(1) R&M / LEP of power stations
(2) Reforms and Restructuring of power sector in India
(3) Strengthening of Transmission and Distribution sector
(4) Environmental Aspects related to power sector in India

5.2 R&M / LEP of Power Stations

Brief details in connection with various planned and ongoing schemes undertaken by GoI are mentioned in Annexure - 3 of this report related to thermal power stations.

5.3 Reforms & Restructuring of Power Sector in India

5.3.1 Transmission & Distribution Losses

In the context of the transmission & distribution losses in the country, the T&D losses are substantially higher due to various shortcomings in the present power sector in India. The T&D losses in the country during 1997-98 were 24.79%. In the mean time, GoI has taken up various steps in order to strengthen the power sector.

It is a well known fact that reduction in technical losses can be achieved by refurbishment of the network. However the end result of achieving reduction in technical losses is primarily dependant upon the investment in the development of the same. Due to the fact that the network varies widely in density, structure, voltage (as they have evolved in time) with variable load factors and system peaks, the reduction of non-technical losses (commercial losses) is an even complex process and therefore can only be gradually achieved.

Reducing T&D losses involves many steps. Some of the significant activities to be undertaken are mentioned below:

- Develop reliable consumer data base
- Metering of all consumers
- Unauthorised consumers to be brought into the billing net
- Development of computerised online billing system
- Installation of capacitors and improvement of power factor
- Energy audit of specified consumers
- Strict enforcement of Electricity Act

The present high level of T&D losses in SEBs reflects a deeply embedded malaise. In this direction, GoI has introduced reforms and restructuring of power sector to curb these losses gradually.

5.3.2 Reform Process in Power Sector

The Common Minimum Plan (CMP) formulated at the Chief Ministers' conference in December'1996 envisaged, inter - alia, setting up Central Electricity Regulatory Commission (CERC) by the GoI. This also includes setting up independent State Electricity Regulatory Commission (SERC) by each state as also rationalisation of tariff structure so that the subsidised sector like agriculture sector would pay at least 50% of the average cost of the generation by the third year. The CERC was expected, among others, to set the bulk tariff for all Central Generation and Transmission Utilities and take up licensing, planning and other related functions, the SERCs were expected to set appropriate tariff and norms for operational efficiencies and to ensure level playing field between various entities in power sector. Based on the aforesaid objective, the Electricity Regulatory Commission Act, 1998 (ERCA) was passed in July'1998. While CERC has already been set up , the status of the State ERC with respect to reform is mentioned in Table 5.1

The private sector participation in T&D sector has also been set in motion with the passing of the T&D bill in the parliament. Transmission Amendment Act was passed in 1998 to enable private participation in Power Transmission sector. Indian Electricity Grid Code (IEGC) has been notified by CERC in January'2000 with a view to ensuring grid discipline, relationship with different players, their role and responsibilities, operation and governance of the system etc. Power Trading Corporation has been set up for inter-state sale of power from Mega power projects. The Availability Based Tariff order notified recently by CERC, is a step towards grid discipline, encouraging greater availability, efficiency and competition in the system at all levels.

Table 5.1 Reforms and Restructuring in State Governments Milestones / Status as of September'2001

State	State Decision to Reform Power Sector	Commissioning of Studies	Passing of Reform Bill	SERC							Unbundling / Corporatisation	Privatisation of Distribution
				Decision to set up SERC	Appointment of selection committee	Joining of Chairperson / Members of SERCs	Farming of Regulations by SERC	Selection of Staff	Issuing Tariff Order	MoU / MoA with GoI		
Arunachal Pradesh	√			√								
Andhra Pradesh	√	√	√	√	√	√	√	√	√	√	√	
Assam	√	√		√	√	√				√		
Bihar	√			√						√		
Chattisgarh										√		
Delhi	√	√	√	√	√	√	√	√	√	√		
Gujarat	√	√	√	√	√	√	√	√	√	√		
Goa	√	√		√	√							
Haryana	√	√	√	√	√	√	√	√	√	√	√	
Himachal Pradesh	√			√	√	√				√		
Jammu & Kashmir	√	√								√		
Jharkhand										√		

State	State Decision to Reform Power Sector	Commissioning of Studies	Passing of Reform Bill	SERC							Unbundling / Corporatisation	Privatisation of Distribution
				Decision to set up SERC	Appointment of selection committee	Joining of Chairperson / Members of SERCs	Farming of Regulations by SERC	Selection of Staff	Issuing Tariff Order	MoU / MoA with GoI		
Karnataka	√	√	√	√	√	√	√	√	√	√	√	
Kerala	√	√		√						√		
Meghalaya	√			√				√				
Madhya Pradesh	√	√	√	√	√	√	√	√		√		
Maharastra	√	√		√	√	√	√	√	√	√		
Manipur	√			√								
Mizoram	√			√								
Nagaland	√			√								
Orissa	√	√	√	√	√	√	√	√	√	√	√	√
Punjab	√	√		√						√		
Rajasthan	√	√	√	√	√	√	√	√	√	√	√	
Tamil Nadu	√	√		√	√	√						
Tripura	√			√								
Uttar Pradesh	√	√	√	√	√	√	√	√	√	√	√	
Uttranchal										√		
West Bengal	√	√		√	√	√	√			√	√	

5.4 Strengthening Transmission And Distribution System

GoI has taken many steps for strengthening T&D system. Hence, implementation of various technical schemes as well as schemes to reduce commercial losses are considered in upcoming plans. GoI has initiated process for strengthening the rural electrification network also.

System improvement programme covers the plan to cater to the power needs of the concerned areas for a period of next 5 to 7 years.

Various measures being taken under this programme to reduce the technical losses and to meet the system inadequacies are as follows:

- Regrouping of load, bifurcation, alignment and augmentation of existing heavily loaded LT feeders and use of energy efficient distribution transformers.
- Provision of reliable protection at LT side of distribution transformers
- Shunt capacitors for PF improvement in LT systems
- Bifurcation, alignment and augmentation of heavily loaded 11KV feeders
- Provision of 11kV automatically switched capacitors directly on lines
- Provision of 11KV voltage boosters, sectionalizers etc
- Construction of new sub stations and augmentation of existing sub stations along with associated feeders etc.
- Shunt compensation at various sub stations in sub transmission systems, by installing HT capacitor banks
- Provision of metering equipment on all incoming and outgoing feeders in the existing / proposed power sub-stations

- Provision of controlling equipment on all incoming and outgoing feeders in the existing / proposed power sub stations

- Provision of controlling equipment, such as, circuit breakers, isolators etc. for the existing feeders and power transformers, wherever necessary

- Communication and automation equipment

- Replacement of worn out sub station equipment

In order to reduce the commercial losses attributed to various reasons, GoI has decided that all consumers shall be metered in a time bound programme, with an efficient and tamper proof metering arrangement.

5.5 Environmental Aspects Related To Power Sector in India

This is covered under Annexure - 4 of this report.

ANNEXURE - 6

STATUS OF SEB IN INDIA

6.1 ANDHRA PRADESH 2
6.2 ASSAM 2
6.3 BIHAR 2
6.4 DELHI 3
6.5 GUJARAT 3
6.6 HARYANA 3
6.7 HIMACHAL PRADESH 4
6.8 JAMMU & KASHMIR 4
6.9 KARNATAKA 4
6.10 KERALA 5
6.11 MADHYA PRADESH 5
6.12 MAHARASHTRA 5
6.13 MEGHALAYA 5
6.14 ORISSA 6
6.15 PUNJAB 6
6.16 RAJASTHAN 6
6.17 TAMILNADU 7
6.18 UTTAR PRADESH 7
6.19 WEST BENGAL 7

We bring hereunder-brief note on functioning of the SEBs as well as the developments taking place:

6.1 Andhra Pradesh

With an average PLF of over 83 per cent in 1999-2000, AP Genco remains one of the better -managed utilities. T&D losses, however, have been high, at 37 per cent. Though the state's peak shortages increased in 2000-2001 to 14.6 per cent ,there has been no appreciable increase in capacity. Meanwhile, the reform process in the state is sailing along smoothly. APERC is fully functional and has already issued a tariff order for 2000-2001. On the distribution privatisation front, independent licences have been issued to four distribution companies. Subsidies have, however, increased over the years yet the utility has managed to realise a rate of return (RoR.) of 3 per cent in 1999-2000 owing to subsidy support of Rs 30.8 billion.

6.2 Assam

Not much activity has been reported in Assam's power sector last year. The board had an energy surplus in 2000-01 and did not add any capacity during 1999-2000. The per capita consumption of the state was only 127 units and its PLF was a pathetic 17.3 per cent in 1999-2000. T&D losses also increased during 1999-2000 to 44 per cent. Apart from the 25 MW operational DLF project, there have been no new private power proposals in the state. Besides a decision to set up an SERC, there has not been any progress on the reforms front. The financial situation of the SEB continues to be dismal. With Rs 523 million subsidies, the board booked Rs 6.9 billion losses and a negative RoR of over 76 per cent.

6.3 Bihar

There was no improvement in the operational and financial situation of the board in 1999-2000. It booked losses amounting to Rs 53.4 billion (with subsides), it had a PLF of 23.9 per cent and the board claimed to have T&D losses of 31 per cent, though the figure is likely to be much higher. Of the total availability of 10.6 billion units in 1999-2000, the board purchased over three-fourths from central sector generators and other states. With Rs 57.6 billions dues owed, the board topped the list of defaulters to central sector generators. There was no development on the reforms front and BSEB had peak shortages of over 14 per cents in 2000-01. During the year, Jharkhand state was carved out of Bihar, thereby creating one more SEB.

6.4 Delhi

There has been some development on the reform front in the state. Six companies have been shortlisted for final bidding for a 51 per cent stake in three proposed distribution companies. However, the board has not added any generation capacity in the past few years, despite peak shortages of over 12 per cent in 1999-2000. The only project that has shown some movement is Pragati Power. On a positive note, the SERC has been set up. It passed its first tariff order in March 2001.On the operational and financial front, the situation of the board deteriorated in 1999-2000. It showed T&D losses of 51 per cent and booked losses amounting to over Rs 11 billion.

6.5 Gujarat

Though like the other states Gujarat booked losses in 1999-2000 (Rs 22.2 billion with subsidies), it remains one of the favourite destinations for private power investment. Two projects - the 655 MW Gujarat Torrent and 515 MW Essar Power- are already operational and others such as GSPC Hazira are making good progress. The state also claims to be serious about reforms. The board has already been unbundled and the SERC is operational. It passed its first tariff order in October 2000. Industry, which accounted for 30 per cent of sales in 1999-2000, contributed about two-thirds of the revenue of the board.

6.6 Haryana

After a headstart in restructuring, the state has almost stalled the reforms process. Privatisation of distribution has not happened and the World Bank recently threatened to cancel its loans to Haryana. However, the SERC is in place and it came out with its first tariff order in December 2000. Apart from Magnum, which runs a 25 MW plant in Gurgaon, no private project showed movement last year. In March 2001,HPGC added a 210 MW unit at Panipat. Despite subsidies of Rs 4.1 billion in 1999-2000, HVPN had a loss of Rs 2 billion.

T&D losses continued to climb-they were 40.8 per cent in 1999-2000. PLF in the same period was 53.2 per cent.

6.7 Himachal Pradesh

The board, which had been in a relatively good position, booked losses in 1999-2000 for the second consecutive year. In fact, the losses increased from Rs 63 million in 1998- 99 to Rs 1.06 billion in 1999-2000. In July 2001, Malana Power commissioned its 86 MW hydel project, the state's first private sector initiative. While the state does not suffer from power shortages, it has immense hydro development potential. Though the board has always shown resistance to restructuring, in January 2001, it set up its SERC and reluctantly agreed to undertake reforms.

6.8 Jammu & Kashmir

The Jammu & Kashmir Power Development Corporation's (JKPDCs) performance showed no improvement in 1999-2000. The capacity utilisation in the state was 40.3 per cent and T&D losses stood at 47 per cent. Owing to high power purchase costs, low tariffs, poor revenue collection and no subsidy support, JKPDC booked losses of Rs 5 billion on a sales revenue of about Rs 4 billion. Some reform efforts in the state are afoot. JKPDC has accepted the ASCI study on the states power sector reforms and in 1999-2000 the state assembly passed a bill for establishment of a SERC.

6.9 Karnataka

KPCLs financial health remained poor during 1999-2000. One reason for this was agricultural consumption, which comprised 39 per cent of the total sales in 1999-2000 and contributed only 6.3 per cent of he total revenue. KPCL was able to show a positive RoR with the help of over Rs 10.5 billion in subsidies. The PLF during the period was 81.2 per cent while the T&D losses booked were 38 per cent. On the reforms front, the state has made steady progress. The SERC is operational and it passed an order for tariff revision in December 2000.

6.10 Kerala

Even though, unlike Karnataka, only 5 per cent of the sales in 1999-2000 were to the agriculture sector, KEB could show a positive 3 per cent RoR owing to a subsidy of over Rs 3.3 billion from the state government.. Only one private sector project –the 159 MW BSES Kochi – is operational in the state. Kerala plans to adopt the profit centre approach to restructure its board, though not much effort has been made in this regard. In July 2001, the state hiked its tariffs by 25 per cent. Recently, the state government also took a decision to set up an SERC.

6.11 Madhya Pradesh

Peak shortages in the state climbed to 29.7 per cent in 1999-2000, while energy shortages stood at 7.1 per cent. The average PLF during the period was 69.4 per cent while T&D losses were about 32 per cent. Even after accounting for state subsidies amounting to Rs 3.1 billion, the board booked losses amounting to Rs 13.7 billion with a negative RoR of 35 per cent. The state government is seeking ADB's assistance for restructuring and reforms. The SERC is fully functional. During 2000-01, the state of Chhattisgarh was carved out of Madhya Pradesh, thereby; creating a new SEB.

6.12 Maharashtra

Owing to Dabhol controversy, MSEB has been in news over the past one year, for all the wrong reasons. The reforms process has totally stalled after the state-wide agitation last year by MSEB employees. Though the board remained, the biggest SEB, with 9,097 MW installed capacity in1999-2000, its operational performance deteriorated with T&D losses climbing to 29.4 percent. Peak shortages stood at 19.3 per cent in 1999-2000.The once-highly-profitable board relied on state subsidies amounting to Rs 20.8 billion to book a 4.5 per cent RoR. Without the subsidies, the losses booked during the same period were Rs 16.8 billion.

6.13 Meghalaya

On the paper, Meghalaya remains an energy-surplus state. However, with a per capita consumption of only 190 units in 1999-2000, there seems to be a huge latent demand. Despite a lucrative consumer mix (51 per cent of the sales is to bulk buyers which account for 58 per cent of the total revenues), MeSEB has been constantly in the red. The board booked losses of over Rs 200 million, despite a subsidy support of Rs 93 million. With over 29 employees for every 1,000 consumers served, the board remains highly over manned. No serious reform and restructuring efforts are visible in the state.

6.14 Orissa

Orissa's reform efforts continue despite increasing apprehension about the success of the model adopted by the state. Under the management of the private operator (AES Corporation), OPGC's PLF improved from 65.5 pre cent in 1998-99 to 71.2 per cent in 1999-2000. However, T&D losses continued to remain high and stood at 44.2 per cent during 1999-2000. On paper, Gridco managed to show some profits during the period, while the private distribution companies had cumulative losses of over Rs 200 million. As against peak shortage of 5.2 per cent in 1999-2000, the state had a 2.2 per cent peak surplus in 2000-01.

6.15 Punjab

Farmers continue to get free power in the state. As a result, the agriculture sector, which accounts for 38 per cent of the total consumption in the state, contributed nothing. PSEB relied heavily on subsidies to show a positive RoR. These subsidies amounted to about Rs 12.2 billion in 1999-2000 and the losses during the same period were Rs 12.1 billion (without subsidy). During 2000-01, PSEB commissioned the 600 MW Ranjit Sagar Dam taking the total installed capacity of the board to about 3,300 MW. Though the SERC is fully operational, the state has not taken up reforms in a big way.

6.16 Rajasthan

Last year, Rajasthan became the seventh state to unbundle its board into one generation, one transmission and three distribution companies. In next phase of restructuring, the state also plans to privatise the distribution companies. The SERC is fully operational and issued its first tariff order in April 2001. During 1999-2000 the states added a 250 MW unit at the existing Suratgarh thermal power station. Despite a moderate operational performance, the board needed subsidies of over Rs 17.6 billion to show the mandatory 3 per cent RoR. The only private project that showed some movement over the past 2 to 3 years- the 702 MW RPG Dholpur project- has also been more or less shelved.

6.17 Tamilnadu

As a result of extending free power to the agriculture sector, Tamilnadu's financial position worsened during 1999-2000. The board could book a positive RoR only due to a subsidy support of Rs 17.7 billion from the state government. The board was, however, better off on operational front . Its PLF increased from 65.6 per cent in 1998-99 to 72.3 per cent in 1999-2000 and its T&D losses during the same period were among the lowest in the country (16.7 %). On the IPP front ,Tamilnadu snowed more progress than most other states. Quite a few IPP projects made progress during the past two years. The GMR Basin Bride, PPN Power and Samalpatti Projects started generation while the 250 MW ST- CMS and 106 MW Samayanallur projects are under construction. The SERC is fully functional.

6.18 Uttar Pradesh

The Uttar Pradesh Board has been unbundled into separate corporations for generation, transmission and distribution. The state's capacity utilisation remained rather poor. Its average PLF was only about 50 per cent during 1999-2000 and the state suffered from about 30 per cent T&D losses. The Power Utility reported losses of about Rs. 17.4 billion (without subsidy). Uttar Pradesh remains one of the biggest debtors to the central utility. As on the March 31' 2000, the state owed almost Rs.35 billion to the central utilities. Meanwhile, the SERC is fully functional and passes its first tariff order in September' 2000. In 2000 – 01, Uttranchal was curved out of the Uttar Pradesh and the new SEB has already been constituted.

6.19 West Bengal

WBSEB did badly on the operational as well as financial front during 1999-2000. Its PLF was 47 per cent while T&D losses were 28 per cent during this period. WESEB booked losses amounting to Rs 10.3 billion with a negative RoR of 146 per cent (without subsidy).

ANNEXURE - 7

ANNEXURE - 7

IDENTIFIED POWER PLANTS FOR IMPLEMENTATION OF SCHEMES

Sr No	Station	Station capacity	Design: HR	1996-97		1997-98		1998-99		1999-20		2000-01		Average	
				HR	% dev	HR	% dev	HR	% dev	HR	% dev	HR	% dev	HR	% dev
		MW	Kcal/kwhr	Kcal/kwhr		Kcal/kwhı		Kcal/kwhr		Kcal/kwlır		Kcal/kwhr		Kcal/kwhr	
1	H"ganj	440	2596	4564	75 81	4492	73.04	4689	80 62	5003	92.72			4687.00	80.55
2	Barauni	320	2532.64	4497	77.56	4918	94.18	4681	84.83	4570	80.44	4537	79.14	4640 60	83.23
3	Parichha	220	2479 34	4537	82 99	4445	79.28	4590	85.13	4216	70.05	3646	47.06	4286 80	72.90
4	Ch"pur(DV	780	2352.24	3836	63 08	3889	65.33	3896	65.65	4109	74.68	4322	83 74	4010 40	70 49
5	Panki	284	2528.47	3934	55 59	3870	53 06	4051	60 22	4206	66 35	4011	58 63	4014 40	58 77
6	Bongaigon	240	2748.55	3690	34 25	4563	66 01	4516	64 30					4256 33	54 86
7	Faridabad	165	2811.25	4195	61 59	4226	50.32	4058	44.35	3976	41.43	4339	54 34	4158 80	47.93
8	Neyveli-I	600	2739.29	3945	44 02	3957	44.45	3958	44.49	4127	50.66	4027	47.01	4002.80	46.13
9	Bokaro	630	2399.35	3616	50 71	3450	43.79	3173	32.24	3386	41.12			3406 25	41.97
10	Obra B	1000	2324	2946	26.76	2900	24.78	3201	37.74	3608	55.25			3163.75	36.13
11	Panipat	650	2425	3348	38.06	3342	37.81	3359	38.52	3108	28.16	3257	34.31	3282.80	35 37
12	Talchar	460	2621.33	3694	40 92	3444	31.38	3257	24.25					3465 00	32.18
13	Durgapur	350	2106	2991	24 31	3085	28.22	2946	22 44	3302	37.24	3552	47 63	3175 20	31.97
14	IP Stn	284.1	2667.39	3458	29 64	3579	34.18	3883	45.57	3403	27.58	3215	20.53	3507.60	31.50
15	Kolagnat	1260	2387.52	3049	27.71	3157	32 23	3164	32 52	3170	32 77			3135.00	31.31
16	Birsingpur	420	2292.83	3124	36 25	2922	27.44	3093	34 90	3093	35 16	2784	21 42	3004 40	31 03
17	Korba Eas	240	2368.6	3324	40.34	2855	20.54	3053	28.89					3077.33	29.92
18	Kutch Lign	215	2744.71	3964	44.42	3617	31.78	3362	22.49	3398	23.80	3442	25.40	3556 60	29.58
19	Ennore	450	2528.21	2939	16.25	3285	29.93	3123	23.53	3268	29.26	3629	43 54	3248 80	28 50
20	Rajghat	135	2580.35	3090	20 06	3129	21.26	3572	38 43	3409	32.11	3243	25 68	3290 20	27.51
21	Obra A	550	2622.9	3232	23 22	3443	31.27	3410	30 01	3390	29 25	3028	15 44	3300 60	25 84
22	K.gudem	680	2541.46	3268	28 59	3226	26.93	3271	28 71	2974	17.02			3184 75	25.31
23	Korba Eas	200	2675.86	3380	26.31	3351	25.23	3273	22.32	3319	24.03			3330 75	24.47
24	Mejja	630	2267.16					2816	24.21					2816.00	24.21
25	Bandel	530	2359.78	2840	20.35	2722	15.35	3042	28.91	3110	31.79			2928 50	24.10
26	GGS Ropa	1260	2259.43	2833	25.52	2754	21.89	2760	22.15	2810	24.37	2829	25.21	2797.80	23.83
27	G N Bhatin	440	2510.19	3091	23 14	3056	21.74	3076	22.54	3053	21.62	3092	23.18	3073.60	22.44
28	Budge Bud	500	2261			3271	44.67	2599	14 95	2359	4.33			2743 00	21.32
29	Paras	62.5	2686.05	3169	17 98	3173	18.13	3164	17.79	3141	16.94	3151	17.31	3159 60	17.63
30	Kha,kheda	420	2274.69	2663	17 07	2713	19 27	2810	23.53	2624	15 36	2556	12 37	2673 20	17.52
31	Hasdeo KV	420	2303	2426	5.34	2503	8.68	2761	19.89	2896	25 75	2760	19 84	2669 20	15 90
32	Koradi	1100	2398.85	2740	14 22	2748	14.55	2778	15.81	2801	16.76	2733	13 93	2760.00	15 06
33	Dhuaran	534	2527 61	2866	13 39	2924	15 68							2895 00	14 54
34	N chennai	630	2324 28	2818	21 24	2686	15.56	2568	10 49	2560	10.14			2658 00	14 36
35	Kota	850	2353 55	2879	22 33	2639	13 40	2596	10.30	2499	5.76	2743	16 55	2675 20	13 67

ANNEXURE - 7

IDENTIFIED POWER PLANTS FOR IMPLEMENTATION OF SCHEMES

Sr No.	Station	Station capacity	Design HR	1996-97		1997-98		1998-99		1999-20		2000-01		Average	
				HR	% dev	HR	% dev	HR	% dev	HR	% dev	HR	% dev	HR	% dev
		MW	Kcal/kwhr	Kcal/kwhr		Kcal/kwhr		Kcal/kwhr		Kcal/kwhr		Kcal/kwhr		Kcal/kwhr	
36	Ukai	850	2358.27	2747	16.48	2663	13.01	2754	17.20	2554	8.30	2617	10.97	2669.40	13.19
37	Rayalseem	420	2223	2728	22.72	2502	12.55	2457	10.53	2360	6.16			2511.75	12.99
38	Sabermali	390	2553.34	2856	11.85	2921	14.40	2918	14.28	2812	10.13			2876.75	12.67
39	Anpara	1630	2358.18	2554	8.30	2739	16.15	2644	12.12	2602	12.88			2649.75	12.36
40	Parli	690	2424.29	2767	14.14	2692	11.04	2720	12.20	2760	13.85	2675	10.34	2722.80	12.31
41	Farakka	1400	2286.69	2544	11.25	2593	13.40	2561	12.00					2566.00	12.21
42	Nasik	910	2347.76	2660	13.30	2687	14.45	2610	11.17	2525	7.55			2620.50	11.62
43	Neveli-ii	1470	2601	2774	6.65	2819	8.38	2940	13.03	2939	13.00	2922	12.34	2878.80	10.68
44	Bhusawal	482.5	2376.26	2840	19.52	2673	12.49	2609	9.79	2504	5.38	2463	3.65	2617.80	10.16

Overall
Capacity 26192.1

Sr No.	Criteria	TOTAL Nos. Of Plant	Heat rate Deviation	PLF in %	Improved PLF after Implementation of such schemes in %	Calorific Value in Kcal/Kg	Average operating HR in KCal/ KWhr	Average Designed HR in Kcal/ Kwhr	Total Capacity in MW	Modified HR as envisa-ged after efficiency improvement	Saving in the Kcal	Reduction CO2 in Kg Per Kwhr	Reduction of CO2 in Million Tonnes		
1	More than 20% deviation	28	**37.34%**	53	60	3800	3363.0	2448.7	13933.1	3060.9	302.1	0.1283	9.39		
2	More than 10% Deviation	16	**12.92%**	77	77	3800	2699.0	2390.3	12259.0	2557.6	141.4	0.0601	4.97		
3	Total	44	**26.05%**				3052.2						14.36		
				% Reduction in the CO2 emission after implementation of Efficiency Improvement schemes at 44 Identified Thermal Power Stations in comparision to existing coal fired thermal power stations in all India basis										4.0	%

ANNEXURE - 8

ANNEXURE - 8

SYNOPSIS OF THREE POWER PLANTS IDENTIFIED UNDER GEF PROGRAMME

KOLAGHAT THERMAL POWER STATION

Place:	Kolaghat	**State:**	West Bengal
Maintained by	WBPDC		
Station capacity:	6X210 MW Thermal Power Station		
Plant supplied by:	BHEL & ABL		
Source of coal	West Bengal Coal Belt		
Source of Cooling water	Rupnarayan River		

Station is synchronised with Eastern grid

Unit No		1	2	3	4	5	6
Capacity	MW	210	210	210	210	210	210
Commission Date		09-09-90	03-09-86	10-12-84	04-01-95	14/05/91	08-01-93
Design Boiler Efficiency	%	88.5	88.5	88.5	88.5	86.4	86.4
Design Turbine Heat Rate	kCal/kWh	2062	2062	2062	2062	2082	2082
Design Station Heat Rate	kCal/kWh	2329.9	2329.9	2329.9	2329.9	2409.7	2409.7
Opearting Values							
Present Average Station Heat Rate	kCal/kWh				3135.0		

Steam Turbine : Make - Russian (LMZ) , three cylinder reheat, condensing type with extractions

	Design Parameters	Operating Parameters
Throttle Pressure	130 Kg/cm2	115 to 122 Kg/cm2
hot Reheat Pressure	24 Kg/cm2	21 to 24.5 Kg/cm2
Condenser vacuum	0.0894 Kg/cm2(a)	.086 to 0.14 Kg/cm2(a)
Throttle temperature	535 Deg C	510 to 525 Deg C
Reheat Temperature	535 Deg C	510 to 530 Deg C

Steam Generator:

Unit 1 to 4: ABL design Front wall natural circulation with E type mills, Dry bottom boiler

Unit 5 and 6: BHEL Tangential corner fired combustion engineering design dry bottom, Natural circulation Boiler

	Design Parameters		Operating Parameters	
Flue gas temperature after preheater	137	Deg C	150 to 163	Deg C
Steam Flow	650	T/hr	700 to 740	T/hr

Average Plant Load Factor	56.3 %	1999-2000	
Coal cost at the yard		1200	Rs/MT
Oil cost		15900	Rs/Kl

Ultimate Analysis of Coal		Design Parameters	Operating Parameters
Carbon	%	47.5	46.8
Hydrogen	%	2.8	3.3
Nitrogen	%	1.0	0.9
Oxygen	%	10.7	4.7
Sulphur	%	0.6	0.4
Ash	%	29.6	36.8
Moisture	%	7.8	7.2
Average Coal GCV	Kcal/kG	4538	4212

ANNEXURE - 8
SYNOPSIS OF THREE POWER PLANTS IDENTIFIED UNDER GEF PROGRAMME

FARIDABAD THERMAL POWER STATION

Place:	Faridabad	**State:**	Haryana
Maintained by	HPGCL		
Station capacity:	3X60 MW Thermal Power Station (De rated to 3X 55 MW)		
Plant supplied by:	BHEL		
Source of coal	Bihar coal belt		
Source of Cooling water	Yamuna Canal		

Station is synchronised with northen grid

Unit No		**1**	**2**	**3**
Capacity	**MW**	**60**	**60**	**60**
Year of Commissioning		**Nov-74**	**Mar-76**	**Apr-8[illegible]**
Design Boiler Efficiency	**%**	**83.5**	**83.5**	**86[illegible]**
Design Turbine Heat Rate	**kCal/kWh**	**2368**	**2368**	**2378**
Design Station Heat Rate	**kCal/kWh**	**2825.93**	**2835.93**	**2761.9[illegible]**

Values considered for Calculation:

Present Average Station Heat Rate	**kCal/kWh**	4158.8

Operating Parameters

Steam Turbine: Make-Skoda doub'e cylinder non reheat, condensing type with extractions

	Design Parameters		**Operating Parameters Unit # 3**		**Operating Parameters Unit # 1 & 2**	
Throttle Pressure	90	Kg/cm2	76 to 83	Kg/cm2	90 to 100	Kg/cm2
Condenser vacuum	0.11	Kg/cm2	0.28 to 0.24	Kg/cm2	0.31 to 0.26	Kg/cm2
Throttle temperature	520	Deg C	512 to 525	Deg C	515 to 530	Deg C

Steam Generator:

Unit1 &2: Skoda design, Single drum natural circulation front wall fired with beater hammer mills, Dry bottom bciler

Unit3: Skoda design, Single drum natural circulationtengential corner fired with Bowl mills, Dry bottom boiler

	Design Parameters		**Operating Parameters Unit # 3**		**Operating Parameters Unit # 1 & 2**	
Flue gas temperature after air preheater	150	Deg C	160 to 175	Deg C	180 to 200	Deg C
Steam Flow	238	T/hr	226	T/hr	210 to 235	T/hr

Average Plant Load Factor	54.56	%	1999-2000	
Coal cost at the yard			2200	Rs/MT
Oil cost			12686	Rs/Kl

Ultimate Analysis of Coal		**Design Parameters**	**Operating Parameters**
Carbon	%	60.0	55.0
Hydrogen	%	4.5	3.8
Nitrogen	%	1.1	1.1
Oxygen	%	7.5	5.9
Sulphur	%	0.0	0.0
Ash	%	22.0	30.4
Moisture	%	4.0	3.8
Average Coal GCV	Kcal/kG	5500 +/- 200	4519

RLA Study : The RLA study of Unit No. 3 for Boiler and Turbine was carried out in year 2000.

ANNEXURE - 8

SYNOPSIS OF THREE POWER PLANTS IDENTIFIED UNDER GEF PROGRAMME

GURU GOBIND SINGH SUPER THERMAL PLANT, ROPAR

Place:	Ropar	**State:**	Punjab
Maintained by	Punjab State Electicity Board		
Station capacity:	6X210 MW Thermal Power Station		
Plant supplied by:	BHEL		
Source of coal	Bihar coal belt		
Source of Cooling water	Bhakra canal		

Station is synchronised with northen grid

Unit No		1	2	3	4	5	6
Capacity	MW	210	210	210	210	210	210
Commission Date		26.09.84	29.03.85	31.03.88	29.01.89	29.03.92	30.03.93
Design Boiler Efficiency	%	87.2	87.2	88.2	88.2	88.2	88.2
Design Turbine Heat Rate	kCal/kWh	1985	1985	1985	1985	1985	1985
Design Station Heat Rate	kCal/kWh	2277.4	2277.4	2277.4	2277.4	2277.4	2277.4
Operating Values							
Present Average Station Heat Rate	kCal/kWh	2774.7					
Operating Parametrs							

Steam Turbine: Make-Siemens(KWU) 3 cylinder reheat, condensing type with extractions

	Design Parameters	**Operating Paramters**
Throttle Pressure	150 Kg/cm2	140 to 147 Kg/cm2
Hot Reheat Pressure	34.6 Kg/cm2	33 to 36 Kg/cm2
Condenser vacuum	0.11 Kg/cm2 (absolute)	0.09 to 0.14 Kg/cm2 (absolute)
Throttle temperature	535 Deg C	530 to 537 Deg C
Reheat Temperature	535 Deg C	530 to 537 Deg C

Steam Generator:Tangential corner fired combustion engineering design dry bottom, Natural circulation Boiler

	Design Parameters	**Operating Parameters**
Flue gas temperature after air preheater	140 Deg C	141 to 160 Deg C
Steam Flow	620 T/hr	660 to 700 T/hr

Average Plant Load Factor	74.32	%	1999-2000	
Coal cost at the yard			1980	Rs/MT
Oil cost			7538	Rs/KL

Ultimate Analysis of Coal		**Design Parameters**	**Operating Parameters**
Carbon	%	47.33	44.86
Hydrogen	%	2.73	2.96
Nitrogen	%	1.04	0.91
Oxygen	%	10.94	4.51
Sulphur	%	0.76	0.32
Ash	%	29.4	39.33
Moisture	%	7.8	7.1
Average Coal GCV	Kcal/Kg	4530	4160

ANNEXURE - 9

SELECTION CRITERIA FOR IDENTIFYING THREE POWER STATIONS UNDER GEF PROGRAMME

TABLE OF CONTENTS

9.1 CRITERIA OF SELECTING KOLAGHAT, FARIDABAD AND GGSSTPS, ROPAR THERMAL POWER STATIONS UNDER GEF PROGRAM 2

9.2 KOLAGHAT THERMAL POWER STATION 4

9.3 FARIDABAD THERMAL POWER PLANT 4

9.4 GURU GOBIND SINGH SUPER THERMAL POWER STATION............... 5

9.1 Criteria for Selection of Kolaghat, Faridabad and GGSSTPS, Ropar Thermal Power Stations under GEF program

Station performance of all coal fired thermal power stations in India was reviewed with reference to station heat rate. After reviewing the performance of all power stations, 44 power stations are found to be very poor in performance and were short listed for efficiency improvement by taking up renovation and modernisation activities so that the heat rate of those power stations may probably be brought down closer to the their design heat rates as they are operating at much higher heat rates than their design values resulting in higher fuel consumption per unit generated. As a result they have been discharging considerably high level of carbon dioxide in the atmosphere. If the efficiency of these generating units is improved and specific coal consumption is brought down, there will be substantial reduction in fuel expenses of the power plant and level of carbon dioxide emission, as brought up here under.

Sl. No	Parameter	Power Stations having deviation more than 20 % as compared with design heat rate	Power Stations having deviation between 10 to 20% as compared with design heat rate
1	No of Power Stations	28	16
2	Weighted average Design Heat rate in Kcal/Kwhr	2448.72	2390.26
3	Weighted average Operating heat rate in Kcal/Kwhr	3362.99	2699.02
4	Weighted average PLF	53 %	77%
5	Calorific value of coal (Kcal/ Kg)	3800	3800
6	Deviation from design heat rate	37 %	13 %
7	Expected Improvement after implementation of	12 %	6 %

Sr. No	**Parameter**	**Power Stations having deviation more than 20 % as compared with design heat rate**	**Power Stations having deviation between 10 to 20% as compared with design heat rate**
	efficiency related R&M schemes (Reduction as % of design value)		
8	Expected reduction in CO_2 emission/annum	9.4 Million T	4.96 Million T

Total expected CO_2 reduction is 14.35 Million tons, which is almost 4 % of the annual CO_2 generation (357 Million tons) from the Indian power sector.

Under programme of Global Environment Facility (GEF), UNDP has been funding several programmes, which are viable for ensuring reduction in emission of green house gas from the global environment. As seen in the above table quite a number of thermal power stations, continue to consume much more fuel than the design requirement and pollute the atmosphere with excessive discharge of carbon dioxide. There is ample scope of bringing reduction in green house gas emission and hence a programme is to be under taken for funding such power stations for taking up R&M activities.

The fund requirement for implementation of such R&M activities in all 44 chosen power stations will be enormous. Hence, on an experimental basis, only three of those power stations are identified to be brought up under the proposed GEF funding to take up R&M activities, which can ensure enhancement of overall plant efficiency. The following are the three identified thermal power stations:

1) Kolaghat thermal power station in West Bengal
2) Faridabad thermal power station in Haryana
3) Guru Gobind Singh Super thermal power station in Punjab

While choosing above thermal power stations for funding under GEF program, the following points were given due consideration:-

1) The power plant to be chosen are really under-performing as compared to their design value

2) There is ample scope for performance improvement after implementation of identified R&M activities
3) Stations having different capacity units, supplied by different manufacturers under different design basis are to be considered.
4) The fuel characteristics and source of fuel must also be different
5) Willingness from power plant authorities for taking up suggested improvement measures and to implement the same.
6) The spent life of units must not be too high or too low.- between 10 to 25 years.
7) PLF should not be very low as compared to national average.

9.2 Kolaghat Thermal Power station

Kolaghat Thermal Power Plant is situated 70 KM south west of Kolkata in West Bengal. It has six (6) units of 210 MW capacity each. Steam generators of first four units are of Babcock and Wilcox, front wall fired design, supplied by ABL, Durgapur and steam generators of unit 5 and 6 are supplied by BHEL. Turbo generators of all the six units are of Russian (LMZ) design and are supplied by BHEL. The first unit was commissioned in the 1984 and the last unit was commissioned in 1995. Present operating heat rate is 3135 Kcal / KWHr, which is almost 31% higher then the designed Heat rate. Because of the old design, the power station suffers from certain chronic problems affecting unit performance. Several activities have been identified and if implemented such activities will bring substantial improvement in heat rate. The station authorities are quite willing to take up such measures, if the required funds are made available.

9.3 Faridabad thermal Power Plant

Faridabad Thermal Power Plant is situated in the middle of the residential cum industrial town of Faridabad. It has three (3) units of 60 MW capacity each, which are derated to 55 MW. Steam generators and steam turbines are manufactured and supplied by BHEL . The first unit was commissioned in the 1974 and the last unit was commissioned in 1981.The performance of the units is consistently very low and the present operating heat rate is 4158 Kcal/kWh and the deviation is 47 % from designed value. Faridabad is also situated far away from the linked coalmines, which are in Bihar. The units are of very old design and have been in operation for the last 20 to 25 years. The power station is situated in a zone of load center. Because of outdated design, the power station suffers very much due to certain problems affecting unit performance. Several activities are identified and if implemented, it will bring substantial improvement in heat rate. The station authorities are quite willing to take up such measures , if the required funds are made available.

9.4 Guru Gobind Singh Super Thermal Power Station

GGSSTP is situated at a site adjacent to Bhakra Main Line Canal near village Ghanauli 12 Kms from Ropar in the state of Punjab. It has six (6) units of 210 MW capacity each. Steam generators of all six units are of BHEL make. Turbo generators of all the six units are of Siemens (KWU) design and are supplied by BHEL. The first unit was commissioned in the 1984 and the last unit was commissioned in 1993. Notably GGSSTP is situated far away from pithead and the station is linked to the coal source from Bihar mines. Coal is transported by rail from far away mines. The average performance of the power station is fairly good in terms of plant load factor but its present heat rate is 2774 Kcal/kWh and deviation is 23 % from the design level. The station suffers from certain chronic problems and implementing energy efficiency activities can improve the heat rate. The station authorities have expressed their willingness to take up such activities.

Common points:

1) All the selected power plants have higher heat rate relative to their design values.
2) All the selected power plant authorities are willing to carry out these R&M activities for improving thermal efficiency of the units.
3) In all the selected power plants R&M activities for performance improvement have already been started or proposals are being framed for funding under APDP scheme.
4) There is financial barrier, which is to be overcome, for taking up such efficiency oriented major R&M activities. The station authorities are quite willing to take up such measures , if the required funds are made available.

ANNEXURE - 10

ANNEXURE - 10

Activities to be Undertaken for the Three Identified Thermal Power Stations

Sr. No.	Activity	Expected reduction in Unit heat rate (kcal/kwhr)	Expected reduction in Station heat rate (kcal/kwhr)	Estimated Cost Rs. Million
A	**KOLAGHAT THERMAL POWER STATION (6X210 MW), KOLAGHAT, WEST BENGAL.**			
1	**Replacement of Complete HP and IP Turbine Rotors with the latest improved design for better efficiency. Removal of Baumann stage and modifying LP cylinder complete with a new LP rotor for unit-1**	84.61	14.10	390
2	**Putting HP Heater#5 in service by replacing Drip Pumps with higher capacity for 1,2,3,4 units**	52.57	35.05	10
3	**Activities for improvement of condenser Vacuum**	121.28	121.28	
3.1	Condenser Tubes Acid Cleaning and Installation of Tube cleaning system for 1 to 6 units			80
3.2	Circulating water chemical scheme , dozing system &Encloser for CW forebay for Unit 5 and 6			5
3.3	Cooling Tower revamping with modern design drift eleminators and fills for 5& 6 units			25
3.4	Construction of settling tank and clarifloculator for make up for cooling tower basin Unit 1-4 to bring down TDS			45
4	**Composite scheme for Boiler Efficiency Improvement**	90.87	90.87	
4.1	Modification of existng milling system with replacement of 8.5 E 10 Mills with 8.5 E 9 Mills and installaton of dynamic classifier, along with PA fans for 1,2,3 units for improvement of combustion efficiency			972
4.2	Modification of existing bowl mills, by provision of rotating vane assembly in place of stationery one, along with installation of dynamic classifier, upgradation of PA fans and modification in hot air gate assembly to aviod hot air losses, to bring improvement in combustion efficiency in Unit 5&6.			35
4.3	To overcome problem of air-in-leak into furnace, by replacement of defective and eroded portion of combustion air ducting and expansion joints to bring improvement in combustion efficiency in all the six units	34.70	34.70	10
4.4	Redoing Insulation of complete Boiler for 1 to 6 Units to avoid rediation losses			8
4.5	Reinstallation of complete Sootblowers system for 1 to 4 units to ensure pressure parts cleanliness to improve boiler efficiency			110

ANNEXURE - 10

Activities to be Undertaken for the Three Identified Thermal Power Stations

Sr. No.	Activity	Expected reduction in *Unit heat rate* (kcal/kwhr)	Expected reduction in *Station heat rate* (kcal/kwhr)	Estimated Cost Rs. Million
4.6	Expected number of Reduction in unit trips and start up firing for all units to avoid forced outages due to combustion / flame stability problems.	2.31	2.31	
5	**Replacement of existing Tubular Air Preheater with Rotary Air Preheaters of new design Double seal arrangement and automatic Seal adjustment, in the same location where the Tubular Air Preheaters are erected for 1,2,3,4 units and provision of Oxygen Analysers after Air Preheaters for all the six Units**	16.56	11.04	522
6	**Reduction in Auxiliary power consumption**		**Refer Note 1**	
6.1	Coal mill upgradation and P A fan Capacity Upgradation for 1,2, &3 units			
6.2	Conveyor belt troughaning angle modification			20
6.3	Repairing Hot air gate for 5 & 6 units			
6.4	Repairing Air & Flue gas leakages for 1 to 6 units			
	TOTAL	**402.91**	**309.35**	**2232**

Note:1 - The reduction in auxiliary power consumption based above schemes specified in Sr.no 6.1 to 6.5 , the generation of each unit will increase 1.1 MW above rated capacity.

B	FARIDABAD THERMAL POWER STATION (3X60MW), FARIDABAD, HARYANA.			
1	**Replacement of High Pressure Heaters with modified design and material (High pressure heaters are kept out of operation at present) for all units**	76.65	76.65	70
2	**Modification of cooling water system for improving cooling water quality and condenser vacuum for all units and providing settling tank and clarifloculator**	555.09	555.09	45
3	**Improving condenser vaccum by modification in air evacuation system, with installation of vacuum pumps for all units**			70
4	**Composite scheme for Boiler Efficiency improvement**	60.51	60.51	

ANNEXURE - 10

Activities to be Undertaken for the Three Identified Thermal Power Stations

Sr. No.	Activity	Expected reduction in Unit heat rate (kcal/kwhr)	Expected reduction in Station heat rate (kcal/kwhr)	Estimated Cost Rs. Million
4.1	Upgrading milling system of Boiler 1 & 2, by replacement of existing hammer mills with BHEL make bowl mills Type XRP-623., incorporating modified fuel firing system of tangential firing and furnace safe guard system, after suitable modification of boiler pressure parts.			400
4.2	Modification of existing bowl mills, by provision of rotating vane assembly in place of stationery one, along with installation of dynamic classifier, upgradation of PA fans and modification in hot air gate assembly to aviod hot air losses, to bring improvement in combustion efficiency in Unit - 3			40
4.3	Redoing Boiler Insulation for all 3 Units to avoid radiation losses			3
4.4	Modification of furnace soot blowing system			25
5	**Replacement top & middle blocks of Tubular Air preheater by modified material and design for 1 & 2 units and provision of oxygen analyser after Air Preheaters in all the three units**	20.24	13.49	52
6	**Reduction on Auxiliary Power Consumption:**			
6.1	Better controllers for ESP, with digital, semi pulse control system for all units		Refer Note-1	4
	TOTAL	712.49	705.74	709.00

Note:1 - The reduction in auxiliary power consumption based above schemes specified in Sr.no 6.0 , the generation of each unit will increase 0.09 MW above rated capacity.

ANNEXURE - 10

Activities to be Undertaken for the Three Identified Thermal Power Stations

Sr. No.	Activity	Expected reduction in Unit heat rate (kcal/kwhr)	Expected reduction in Station heat rate (kcal/kwhr)	Estimated Cost Rs. Million
C	GURU GOBIND SINGH SUPER THERMAL PLANT (6X210 MW), ROPAR, PUNJAB.			
1	Replacement of High Pressure Heater Tube Bundle in the existing HPH shell with modified design and material for 1,2,3,4,5 & 6 units	29.28	29.28	190
2	Modification of cooling water system for reduction of cooling water inlet temperature by installation of new Natural Draft Cooling Towers for 5 & 6 units	15.84	5.28	230
3	Modification of cooling water system for 1,2,3 & 4 units to reduce under cooling.	2.82	1.88	
4	Composite scheme for Boiler Efficiency improvement for 1,2,3,4,5 & 6 units	26.60	26.60	
4.1	Modification of existing bowl mills, by provision of rotating vane assembly in place of stationery one, along with installation of dynamic classifier, upgradation of FA fans, replacement of coal nozzle assembly and modification in hot air gate assembly to aviod hot air losses, to bring improvement in combustion efficiency			500
4.2	Restoring Functionality of auto Burner Control System/master control to bring improvement in Combustion Efficiency.			26
4.3	Expected number of Reduction in unit trips and start up firing for all units to avoid forced outages due to combustion / flame stability problems.	2.57	2.57	
5	Replacement of Air Preheater element by modified material and design having double lip seals and automatic seal adjustment system for 1,2,3 &4 units and provision of oxygen analyser after Air Preheater in Units 1- 6	28.10	18.73	164
6	Reduction in auxiliary power consumption by the activities :		Refer Note-1	290
6.1	Providing VFD system for ID fan for all units			
6.2	Installation of modernised digital semi pulse ESP's controls for All units			
	TOTAL	105.21	84.34	1400.00

Note:1 - The reduction in auxiliary power consumption based above schemes specified in Sr.no 6.1 to 6.2 , the generation of each unit will increase 0.59 MW above rated capacity.

ANNEXURE - 11

JUSTIFICATION OF ACTIVITIES TO BE UNDERTAKEN IN THREE IDENTIFIED THERMAL POWER PROJECTS

Table of Contents

11.1 BACKGROUND 3
11.2 KOLAGHAT THERMAL POWER PLANT: 4
  11.2.1 Activity No. 1 5
  11.2.2 Activity No. 2 7
  11.2.3 Activity No. - 3 8
  11.2.3.1 Sub Activity No. 3.1, 3.2 & 3.4 8
  11.2.3.2 Sub Activity No 3.3 10
  11.2.4 Activity No. 4 11
  11.2.4.1 Sub Activity No. 4.1 12
  11.2.4.2 Sub Activity No. 4.2 13
  11.2.4.3 Sub Activity No. 4.3 17
  11.2.4.4 Sub Activity No. 4.4 18
  11.2.4.5 Activity No. 4.5 19
  11.2.5 Activity No. 5 20
  11.2.6 Activity No. 6 21
  11.2.6.1 Sub Activity No. 6.1 & 6.2 21
11.3 FARIDABAD THERMAL POWER PLANT 23
  11.3.1 Activity No. 1 23
  11.3.2 Activity No. 2 24

11.3.3 Activity No. 3 25
11.3.4 Activity - 4 26
  11.3.4.1 Sub Activity No. 4.1 27
  11.3.4.2 Sub Activity No. 4.2 28
  11.3.4.3 Sub Activity No. 4.3 30
  11.3.4.4 Sub Activity No 4. 4 31
11.3.5 Activity No. 5 32
11.3.6 Activity No. 6 33
  13.3.6.1 Sub Activity No 6.1 33
11.4 GURU GOBIND SINGH SUPER THERMAL POWER PLANT, ROPAR 34
11.4.1 Activity No. 1 34
11.4.2 Activity No. 2 35
11.4.3 Activity No. 3 36
11.4.4 Activity No. 4 38
  11.4.4.1 Sub Activity No. 4.1 & 4.2 39
11.4.5 Activity No. 5 42
11.4.6 Activity No. 6 44
  11.4.6.1 Sub Activity No. 6.1 44
  11.4.6.2 Sub Activity No. 6.2 44

11.1 Background

Green House Gas Emission and its effect on Global Climate is a serious matter, which has attracted the attention of the whole world. The extent of damages it is causing to the environment is enormous, which can not be ignored or just kept aside for the future generation. We must act now so that our future generations may live in clean environment.

World over numerous Thermal Power stations go on producing excessive Carbon-di-Oxide (CO2) gas, in addition to NOx and SOx and letting it into atmosphere continuously. In the field of energy, Thermal Power Plants play a vital role and it is simply impossible to do away with burning of coal or oil for the process of generating power or to totally depend on hydel or nuclear power alone. The only way to see that the Thermal Power Houses do not continue to pollute indiscriminately, is to ensure that they work to their optimum level of efficiency.

In Indian energy scenario, nuclear option is very limited. Tapping of hydel power is going on, in spite of the danger it is going to create on ecology and biosphere. Harnessing non-conventional energy sources has its own problems, such as resourcing, high cost of generation, prevailing economics conditions, the viability etc. The best option before us is to go for improving the efficiency of the existing thermal power plants. Many of the thermal power plants in India have become aged and their efficiency is deteriorating day by day. There is a urgent need to modernize the system and revamp working of the power plants. The GoI has already initiated programme for R&M of old power stations by providing suitable funds. Due to limitation of funds, the R&M programme had been aimed at only improving the availability of the old plants and to reduce particulate emission from the plants. There is a need to bring improvement in the thermal efficiency of the power stations along with the availability and to ensure that both the domestic benefits as well as global benefits ensue. Financing of Renovation and Modernization schemes has been a major problem due to resources constraints. Lack of awareness about the need to run the plants more efficiently has been another constraint.

After a thorough review of the prevailing situation in the power generation, Central Electricity Authority, under Ministry of Power, Government of India, has identified forty four Thermal Power Stations in India, which have number of units operating for nearly 10 to 25 Years. These plants are not operating efficiently and there is ample scope for improving their thermal efficiency by Renovation and Modernization of the units. But in the present state of affairs it would be a tremendous task to raise funds to go for R&M of all these units at a stretch. Hence CEA have chosen only three of those forty four (44) stations, namely, Kolaghat Thermai Power Station in West Bengal, Faridabad Thermal Power Station, Faridabad, in Haryana and Guru Gobind Singh Super Thermal Power Station (GGSSTPS) in Punjab. This chapter describes the specific areas, wherein major problems exist, affecting the overall efficiency of the units in each of these power stations, the type of revamping activities to be taken up for ensuring the restoration of efficiency to the design rating and its effect on reduction in Green House Gases in the atmosphere. The synopsis on the plant details and performance data of these three power stations are separately brought out in the Annexure – 8.

11.2 Kolaghat Thermal Power Plant:

Kolaghat Thermal Power Plant is situated 70 KM south west of Kolkata, in West Bengal. It has six (6) units of 210 MW capacity of each. Steam generators of first four units are of Babcock and Wilcox make, front wall fired design, supplied by ABL, Durgapur and steam generators of unit 5 and 6 are supplied by BHEL. Turbo generators of all the six units are of Russian (LMZ) design and are supplied by BHEL, Haridwar. Though the units are being operated at rated capacity, the operating efficiency has deteriorated over the years. There is an ongoing R&M program, under Government funding scheme, to revamp and modernize the units, so that, considerable improvement in availability and generation could be brought in from the present level. To restore the efficiency to the rated design value some of the activities have been identified. With implementation of these measures, it is expected that the plant efficiency will show remarkable improvement and it would directly reflect on Carbon-Dioxide emission into atmosphere. Various problems encountered affecting the plant efficiency and the remedial actions to be immediately implemented are discussed below.

11.2.1 Activity No. 1

Applicable for the Unit: 1 (A-1 of Annexure-10)

Removal of Baumann stage by suitably modifying the LP cylinder and replacing the LP Rotor, with the new improved design:

Replacing existing HP and IP Turbine Rotors with the latest improved design:

All the six units Steam Turbines installed in Kolaghat Thermal Power Plant are of old Russian design of LMZ make of capacity 210 MW each. LP cylinder efficiency is very poor in all these machines. In LMZ design, there is a provision of a special stage called Baumann's stage at the penultimate stage to minimize erosion of last stage blades by water particles . Under this arrangement steam flowing over the top one third of the rotor blades of penultimate stage exits into the condenser, instead of going to the last stage of LP Turbine. Hence a portion of the steam flow is not doing any work, in the last stage of LP turbine and is dumped to condenser exhaust space.

Now that better erosion resistant materials are available for last stages of LP turbine, BHEL, the original manufacturer of the machine, have designed new LP Rotors for these old machines. In the new design, the Baumann stage has been eliminated. The entire LP Cylinder may have to be replaced to get the advantage of these new design LP rotors. In the new design LP cylinder, the entire blade length is exposed to the steam flow path. The entire steam flow gets on to flow through all the stages with out any by passing to condenser.

Meantime BHEL have come out with suggestion that they have redesigned the entire HP / IP / LP rotor assembly with reaction stages and modified gland sealing arrangements. The new design rotor blades will have new profile angle for improved conversion of thermal energy. The changed gland sealing arrangement will reduce gland leakage losses and avoid loss due to friction with the rotor. In their opinion the modified rotor is versatile and works at very high efficiency, since flow path losses are reduced to minimum. With the change in design of LP rotor and the cylinder, the steam turbine output is also likely to increase due to improvement in conversion efficiency.

On an experimental basis, it is proposed to replace all the three existing old design HP/IP/LP rotor assemblies, with the new, improved, highly efficient, design of new HP/IP/LP rotor assemblies of BHEL make and avail of the advantage of additional efficiency / lower heat rate. The new LP rotor will be without Baumann stage, as described above. The same modification can be done in a phased manner at a later stage in other units also.

Action to be taken:

It is suggested to go in for replacement of all the three HP/IP/LP rotors of Unit 1 with modified new design rotors of BHEL make with reaction blades and improved gland and inter stage sealing arrangement, so that added advantage of improved efficiency can be obtained. While going for LP Rotor replacement, Baumann stage would be removed. To suit the new design LP rotor, the LP cylinder casing also has to be replaced with a new design.

Advantages:

- There will be increase in turbine output.
- Additional benefit of improved heat rate will be obtained.
- New rotor will give renewed extended life to turbine.
- The HP & LP rotors removed from unit 1 can be used as spares tor other units.
- Plant overall efficiency will increase with improved design of turbine rotors.
- Improvement in the overall efficiency of the station, reduction in fuel consumption and consequently carbon-di-oxide emission will also be reduced.
- There are 67 Steam Turbines of LMZ design, having Baumann stage in LP turbine, supplied by BHEL for various power stations in the country. If the proposed modification for removal of Baumann stage is proved successful in KTPS, it can be done in phased manner in all those 67 steam turbines. After implementation of the modification, the reduction in carbon-di-oxide emission from all those units will be substantial.

11.2.2 Activity No. 2 (A-2 of Annexure-10)

Putting HP Heater #5 in service by replacement of drip pump with one of higher capacity

Applicable for the Units: 1,2,3&4

It has been observed that HP Heater No.5 is not being taken in service for a long time, because the existing drip pump was designed for lower capacity. If the heater is taken in operation ,the drip whose pressure is lower, can not be pumped to Deaerator directly, since the Deaerator is located above the bunker floor i.e. at 40 M level. So the drip is to be cascaded to LPH 4, necessarily at low load operation. The incoming drip from HPH 5 is at higher temperature and it flashes into steam on entry into LPH 4. The entry of drip from HPH 5 is in the form of steam instead of drip water, thus eroding LPH 4 tubes. Due to frequent tube failures the LPH 4 availability is reduced and it again affects the efficiency as the final condensate temperature achieved is too low.

At higher unit loads, more steam flows from extraction line to HPH 5 and hence drip level rises rapidly. The HPH 5 Drip pump capacity is not adequate to transfer the entire quantity to Deaerator. As a result the HPH 5 drip level goes very high and the HPH group protections acts. All the HP heaters get isolated. To avoid such problem, the HPH 5 is normally not taken in operation. Unless the existing Drip pump is replaced with higher capacity pump ,this problem can not be solved.

It is observed that the feed water temperature at economizer inlet to boiler was lower than the design value. Presently the feed water temperature at inlet to boiler is around 220°C, as against 240°C (design value). By taking in HPH 5 in operation the feed water temperature will be restored to 240°C. If the feed inlet temperature is lower than the design, more fuel is to be fired into the boiler, which will ultimately result in poor unit efficiency and increased CO_2 emission.

Actions to be taken:

Replace the existing drip pump with higher capacity & head and put the HP Heater 5 into service.

Advantages:

- Reduction in Coal Consumption
- Improvement in Turbine Heat Rate at least by 52.57 Kcal/Kwhr
- Ultimate result in efficiency improvement in boiler operation, leading to reduced CO_2 emission through the stack.

11.2.3 Activity No. - 3 (A-3 of Annexure-10)

Activities for improvement of Condenser Vacuum

11.2.3.1 Sub Activity No. 3.1, 3.2 & 3.4

Applicable for the Units: Activity 3.1 for Units 1,2,3,4,5&6,
Activity 3.2 for Units 5 & 6
Activity 3.4 for Units 1,2,3 & 4.

Presently the condenser vacuum is low and is not improving by taking any routine action The condenser vacuum is supposed to be maintained at 680 mm Hg, at 210 MW load. But condenser vacuum is presently maintained at 635 mm Hg for 5&6 units and 640 mm Hg for 1,2,3 &4 units. About 40-45 mm Hg of condenser vacuum is lost and is seriously affecting the heat rate of the steam turbine.

The problem was thoroughly analyzed and it is confirmed that the scaling of waterside of the tubes is the main culprit. Though in the beginning, when the units were new, the condenser vacuum was good, it is observed that there was gradual deterioration in condenser vacuum with the passage of time. During annual maintenance period condenser inspections were carried out and found that the condenser tubes were fouling with salt deposits resulting in poor heat transfer.

In 1996 acid cleaning of the condenser tubes was carried out. Substantial scaling materials were found and removed. After the acid cleaning, the condenser vacuum again had considerably improved. Again gradual deterioration was observed and at present the vacuum is very low (635 mm Hg.)

In unit 5 & 6 softened water is being used in condenser cooling water system, whereas simply raw water is used in units 1 to 4. In Units 1 to 4 though the condenser vacuum is low, but it is not so bad as in Units 5&6. In unit 1 to 4 sulfuric acid treatment is being done and the cooling water Ph is maintained at 8 to 8.5, whereas in unit 5&6 the cooling water Ph is as high as 9.5, which is not good for any cooling water system. The reason for very high Ph in Units 5 and 6 is that the sulfuric acid dosing system is not put into operation.

The softener removes temporary hardness, caused by calcium and magnesium compounds. But sodium compounds, mainly chlorides, are found to be very high and are not effectively getting removed in the softener. The effluent of softener is always highly alkaline, with Ph at 9.5. At highly alkaline atmosphere scales get deposited inside the condenser tubes . The only solution is to carry out condenser tube acid cleaning in all units and install on line tube cleaning system, so that the scaling of condenser tubes does not take place.

It is observed that the circulating water for units 1 to 4 is too turbid and muddy. During rainy season the in flow from the river is turbid. The mud and dirt get settled over in tube inner surfaces and the scaling problem escalates.

To overcome such problem created by turbid make up water flow, it is essential to construct a settling tank, before the make up water is taken to cooling tower basin, so that the mud and sand will settle down considerably. Settling tank alone can not remove all the turbidity in the make up water. It is also required to construct a Clarifloculator for the in coming make up water flow to ensure clean and clear water for condenser cooling water system.

Stage II Cooling Water Fore bay is located just adjacent to coal crusher house of stage II, which is prone for dusty atmosphere Coal dust settles over the water surface making a thin layer of floating coal dust. The dust is carried along with the water in the circulation and settles down at pockets of low circulation zones, inside of the tube surfaces etc. It is now impossible to relocate either the CW fore bay or the coal crusher. Covering water forebays may help to overcome problem.

Action to be taken:

- Sulfuric acid dosing system is to be revamped and made to function. Sulfuric acid treatment is to be started to bring down Ph to around 8 to 8.5.
- Condenser tube cleaning system is to be installed for all units, so that the scale deposit does not take place again. Before that condenser tube acid cleaning is to be necessarily carried out in all units to remove the existing scale deposits .
- To construct a covered low level shed with transparent sheets, to prevent coal dust getting settled over water surface.
- Construction of settling tank and clarifloculator for incoming make up water.

Advantages:

- Condenser vacuum will improve and will be maintained.
- Steam Turbine Heat Rate will come down drastically.
- By acid cleaning present scale deposit will be removed.
- By sulfuric acid dosing scaling will be prevented.
- Tube cleaning will maintain a clean tube wall, prevent scale deposit.
- Coverage over fore bay will help to prevent coal deposit settling.
- Heat transfer efficiency will improve.
- Make up water will be clean and clear by construction of settling tank and Clarifloculator.

11.2.3.2 Sub Activity No 3.3

Very Poor Performance of Cooling Tower

Applicable for the Units: 5 & 6

The cooling towers are cross flow type with induced draft fans. They are of concrete structure. Cooling Towers have become old. The fills have gradually fallen down. The drift eliminators are broken at many places.

Hence expected cooling effect is not achieved. Evaporation losses and drift losses are on higher side.

Action to be taken:

- The internals of the existing unit 5&6 cooling towers are to be removed completely. New design drift eliminators, which are more efficient, are to be fitted.
- New fill materials are to be installed.
- Cooling tower basin is to be cleaned.
- New spray nozzles are to be fitted for proper water distribution.

Advantages:

- Cooling Tower efficiency will increase. Better cooling range will be obtained.
- It will help to improve condenser vacuum
- With improved condenser vacuum Steam Turbine Heat Rate will go down substantially.

11.2.4 Activity No. 4 (A- 4 of Annexure-10)

Composite scheme for Boiler Efficiency improvement

Boiler efficiency mainly depends on the combustion regime in the furnace.

Better the combustion, higher will be the boiler efficiency. For improving the combustion regime it is essential to ensure that the pulverizers are maintained and operated in the best of their performance level. Furnace is to be kept clean and fouling of heat absorbing surfaces must be prevented by periodic soot blowing operation. The automatic controls are to be tuned to get the best results of perfect combustion.

Problems affecting the combustion and heat transfer efficiency are dealt with in detail hereunder:

11.2.4.1 Sub Activity No. 4.1

Modification of Existing Milling System With Replacement of 8.5E 10 Mills with 8.5E 9 Mills

Applicable for the Units: 1,2 & 3

First three boilers are supplied with six Coal Pulverisers of ball and race design, type 8.5 E 10 mills, which has a capacity of 24 T/Hr. The boiler needs to be fired 120 T/Hr of coal of the design quality. As received coal on many occasions is found to contain foreign materials, shells, shanks and stones. The coal pulvarizers break down quite frequently, due to entrapment of such unwanted substances. It is now observed that all the six coal pulverizers have to be kept running throughout, to achieve rated capacity generation. If one of the pulveriser breaks down or is taken out for maintenance ,the generation is to be reduced by 15% to 20 % of the rated capacity. By running six pulverizers the auxiliary power consumption also goes up. Combustion air gets distributed to all the six mills in operation. This brings restrictions on the capacity of the Primary air Fans resulting in adequate coal mixer velocity in coal / air mixer pipes. Furnace combustion regime gets affected due to inadequate entry velocity at burner nozzles. Loss due to unburned in ash goes up and the boiler efficiency gets badly affected.

Action to be taken:

The fourth unit is supplied with coal pulverisers of higher capacity type 8.5 E 9 mills, which can deliver more than 30 T/Hr. And for rated out put only four pulverisers and occasionally five pulvarisers are being used. It is

proposed to replace the existing coal pulvarisers type 8.5 E 10 mills of first three units with type 8.5 E 9 mills to ensure continuous four-mill operation instead of six-mill operation.

Advantages:

- Reduced maintenance & reduction in down time thereby reduced partial load operation
- Lower Auxiliary Power consumption

- Reduction in unburned in bottom and fly ash
- Better combustion can be maintained
- Due to improved combustion, increased heat transfer is ensured
- Ultimate result in reduction in CO_2 emission

11.2.4.2 Sub Activity No. 4.2

Modification of Existing Bowl Mills

Applicable for the Units: 5 & 6

Unit 5 & 6 boilers of KTPS, Kolaghat, are supplied with bowl mills. With the passage of time the output of mill and the fineness of the coal deteriorates due to wearing out of mill rolls and bullring segments. Due to continuous operation and the abrasive quality of coal, the mill components wear out very fast. It is reported that the life of grinding rolls is only 2500 Hours approximately. The grinding capability gets deteriorated very fast. With the result all the six coal pulverizers are kept running to achieve rated capacity generation resulting in higher auxiliary power consumption. Due to non-availability of mills, on many occasions, the units are to be operated on partial load. Some of the main problems faced in these mills are frequent jamming of journal assemblies, fast erosion and collar formation of grinding elements, fast erosion of other mill components, frequent failure of scraper assembly, high mill rejects, inconsistency in coal fineness etc. The additional problems related to coal burner nozzle assemblies, bottlenecks in fuel firing system etc. if tackled well by retrofitting with improved design and material, the boiler efficiency will improve on account of better combustion and greater flame stability.

The flame stability will also bring reduction in number of forced outages. Invariably, due to erosion of bullring segments and grinding rolls, fineness gets deteriorated and the pass through on 200-mesh sieve falls down below 45% which should normally be 70%.

Bad performance of coal classifier is yet another reason for disturbance in combustion region and affecting boiler thermal efficiency. This is a common problem in all the six units and not confined to unit 5 & 6 alone.

The existing coal classifier is static and integral with the Pulverizer. Due to pulverized coal, the classifier body gets eroded very fast. Due to big opening in the classifier body the coarser particles get by passed and enter the outlet stream of the coal flow path of the classifier. Another component greatly affected by coal erosion is the diversion vane assembly. If the vanes are eroded, coal particles find easy flow path and the coarser particles too escape with coal dust. Hence separation of coarser particles does not take place properly. Coarser particles pass through coal pipe and enter the combustion zone of the furnace. Coarser particles do take too long time for complete burning. Invariably either they fall down to the furnace bottom along with slag or get carried away with the fly ash. Due to this combustion efficiency gets greatly affected.

Another major factor affecting the performance of coal pulverizing system is erosion of coal pipes and loss of heat in leaking coal and wastage in auxiliary power, in grinding additional quantity of coal

Due to abrasive nature of the coal dust, coal pipes get eroded very fast, especially the coal pipe bends are severely affected. Coal pipes and bends get punctured and hot pulverized coal leaks out. The leaking coal dust carries away with it good potential of heat energy. This heat is simply wasted in addition to loss of coal. Further excess grinding power is also used in pulverizing the coal, which is being wasted on leakage. Considerable auxiliary power can be saved if the coal dust leakage is arrested. Cast iron coal pipe bends, which are presently being used, have very short span of life and do not last even for a year. If ceramic lined bends are used, in place of these cast iron bends, the life will increase. Considerable saving on maintenance expenditure can also be achieved.

Yet another area where more attention is required is in fuel oil accounting and computation of specific oil consumption. This will be applicable for all the Units: 1,2,3,4,5 & 6

General tendency is to keep the oil support even when unit is running at higher load. Such tendency can be very well overcome and curtailed, if the oil flow is measured exactly and displayed in the control room. Oil Flow meter is used to display flow of oil at any moment of time and exactly accounting total oil consumption on a day to day basis in each boiler. If such devices are not available, the quantity of oil used can not be accounted for, accurately during start-up and for support firing. Presently the oil consumption is roughly estimated by change in tank level. At present in Kolaghat, oil flow meters are not installed in stage-I (Unit – 1,2,3,4) and in stage-II (Unit – 5,6), the oil flow indicators are not working.

Hot air gates in the milling system are meant for isolating hot air, whenever any maintenance work is to be taken up in the coal Pulveriser. But the hot air gates have become a source of continuous hot air leak. Lip seals are worn out. There are gaps in the ducts where the blade plate of the damper mechanism is to operate. Hot air leaks out through these openings. There is always unaccounted heat loss along with the leaking air. Also the fans have to over work to compensate for supply of additional quantity of air lost in leakage. Hence the fan-input power will increase, resulting in high auxiliary power.

There are 12 numbers of hot air gates in one unit. Assuming at least 20 % of hot air is leaking through worn out seals, about 20% of PA fan power can be saved. The energy saved is roughly estimated at 2.2 Million Kw. Hr, if the existing inefficient hot air gates are replaced.

Action to be taken:

The present coal mills are to be modified with improved design features offered by BHEL. The modification of mills would involve replacement of grinding rolls with 'weld overlay' or 'high chrome grinding rolls', embedded with hardened carbide strips, replacement of present bullring segments with modified bullring segments, with stringent specification on hardness, in superior chromium quality, to suit Indian Coal, which are abrasive in nature. Presence of quartz in Indian coal aggravates the situation, by causing faster wear out of mill components. Another important change is the installation of rotating air port assembly in the mills, 'which will limit turbulence inside the mill and will also help considerably in reducing the wear out of mill components. These design changes in the milling system will improve the performance and increase the output of the mills, in addition to bringing in required consistency in grinding efficiency. The proposed modifications in the mills will result in improved life of the mill internals and in increased availability. With improvement in coal mill performance, stability in combustion will be established and support oil firing in furnace may considerably be brought down.

Further introducing re-designed coal nozzle buckets, revamping firing equipment accessories etc. will help in a great way in further improvement in combustion regime.

The existing classifiers will be replaced with new design of 'Rotary Vane type Classifiers', which are more efficient, in separating coarser particles and recirculating them into the Pulverizers, in all the six units. With the modifications envisaged, wear out of diversifier vanes will be considerably reduced and the life of vane assembly will be extended. When the body-wear and diversifier vane-wear problems are tackled, the coal particle separation efficiency of the classifier increases automatically.

It is essential to arrest coal pipe leakage by replacing the existing coal pipes bends with ceramic lined erosion resistance pipe bends. This is applicable for all the six units.

It is proposed to install fuel oil flow meter in the oil line for measurement of oil flow to each boiler 'so that the oil consumption can be accurately estimated. Type of flow meter proposed is Coriolis type

Existing hot air gates are to be replaced with new improved design guillotine gates with pneumatic power cylinder operation.

Advantages:

- Better combustion can be maintained
- Minimum wear and tear and hence reliable and improved performance of pulverizers.
- Reduced maintenance and improved availability of coal pulverisers This will help in avoiding partial load operation. Since units can be run almost on full capacity with improved coal mills availability, the unit efficiency will increase.
- Improved fineness control of coal fed to the furnace
- Due to improved combustion, increased heat transfer is ensured
- Rotary vane type classifiers are more efficient in separating the coarser particles and recirculating them.

- Fineness of coal at classifier out let will be ensured at 70% pass through 200 mesh and retention of coarser particles in 50 mesh will be kept within 1%
- Due to improved coal mill performance and classifiers, the unburned in bottom ash and fly ash will come down to design value. Reduction in unburned in bottom and fly ash will improve boiler efficiency.
- Maintenance on classifier and the mill down time is reduced.
- Coal wastage will be eliminated.
- Heat carried by wasted coal will be saved.
- Saving in Auxiliary power
- Reduction in CO_2 emission with all the benefits as brought out above.
- Exact consumption of fuel oil for start up and support firing can be determined. Tendency to fire excessive oil for support firing will be curtailed.
- Hot air loss will be drastically reduced
- Ultimate result in efficiency improvement in boiler operation.

11.2.4.3 Sub Activity No. 4.3

Leakage of air from hot air ducts and air ingress into flue gas ducts.

Applicable in Units 1,2,3,4,5 & 6

Due to atmospheric and coal ash erosion, the hot air ducts and flue gas ducts have thinned out and are punctured at many places. Due to corrosion effect some of duct welds and furnace skin casing plate welds have cracked. As a result hot air leaks through the ducts at many locations. Unwanted cold air leaks into furnace and all along the flue gas path. Due to leaking hot air there is always heat loss. ID and FD fans get over loaded due to increased load on account of leaking air.

Designed combustion air required for full load operation is 840 TPH.

Estimated air leak through air ducts is around 100 TPH.

FD Fan capacity is 420 TPH and motor rating is 760 KW

At least one fourth of Fan energy is wasted to compensate for leakages.

It is expected that at least 15 million Kw hr. energy can be saved per year if the leakages are arrested.

Similarly in Primary Air circuit, assuming that at least 20% of duct air is leaking, approximately 3.5 million KW hr. power is expected to be saved, if the duct leakage is arrested.

Action to be taken:

A thorough survey is to be made to identify all damaged, eroded and corroded sections of the hot air ducts and flue gas path. Visual inspection, after stripping of insulation and carrying out thickness survey may help in exactly locating the damaged portions. Identified sections of the ducting are to be replaced, with newly fabricated ducts.

Also the worn out, warped and cracked furnace and roof skin casing plates are also to be totally replaced.

Generally the expansion joints in the air and flue ducts get worn out and damaged in due course of operation, since they are fabricated out of very thin sheets. After about 10 to 15 years of operation these expansion joints need total replacement.

Advantages

- Hot air loss through ducts will be eliminated.
- Unwanted cold air in leak into furnace and flue gas path will be eliminated.
- Unwanted cooling of hot flue gas will be stopped.
- Additional power required, for compensating leakage air, will be saved.
- Ultimate result in efficiency improvement in boiler operation.

11.2.4.4 Sub Activity No. 4.4

Redoing of Boiler Insulation

Applicable for the Units: 1,2,3,4,5 & 6

Due to ageing and soaking in rainwater the boiler insulation is damaged heavily. At many places the glass wool insulation has lost its quality and has become ineffective. Hence the radiation heat loss has gone up. Normally radiation and unaccounted losses will be within 0.5%. But now with present status of poor insulation the radiation and unaccounted losses are around 1.5%.

Action to be taken:

Remove the complete boiler refractory and insulation and redo the entire insulation work with improved and latest high quality material.

Advantages:

- Radiation heat loss will be arrested.
- Ultimate result in boiler efficiency improvement.

11.2.4.5 Activity No. 4.5

Reinstallation of Complete Soot blowers

Applicable for the Units: 1,2,3&4

Soot Blowers are damaged and have become inoperative. Due to passing of soot blower inlet steam valves there used to be tubes failures. Sometimes blower lance used to get stuck in the furnace, making withdrawal of blower lance difficult. The delay in withdrawal of lance tube can cause more damage to pressure parts. Since the soot blowers are not being operated the flue gas temperature at Stack inlet has increased to more than 150°C, as against predicted temperature of 137°C. The existing Soot Blower control system has become outdated and the control panels are not in good operating condition. There is no automatic sequential operation through the existing outdated control panels. Modern designs of digital controls, which can automatically come into operation, on detection of furnace fouling, sensing through flue gas temperature probes, are to be installed in furnace.

Action to be taken:

Replace all soot blowers with new modern design equipment. Install modern digital auto control system for operating soot blowers.

Advantages:

- Reliable and high availability of soot blower system will help in keeping heat transfer surfaces in clean condition.
- High heat-pick up in furnace walls and super heater coils.
- Improved operation efficiency.
- Boiler outages due to tube failure will be avoided.
- Through intelligence control system the soot blowers will automatically come into operation as and when there is dire necessity. Unnecessary operation of blowers will not be there.
- Auxiliary power consumption can also be saved if the cycle of operation is need based.

11.2.5 Activity No. 5 (A-5 of Annexure-10)

Replacing existing recuperative type Tubular Air Preheaters with new design regenerative type rotary Air Preheaters:

Applicable for the Units: 1,2,3 & 4

Indian coal contains upto 40 to 45 % of ash, which is highly abrasive in nature. Due to ash erosion, air preheater tubes are getting punctured. Flue Gas flows through the inside of tubes of the air preheater. Combustion air, which is at higher pressure, flows outside the tubes. Combustion air, by short circuiting, finds its way through the damaged tubes and gets into flue gas path. It has become necessary to replace more than 10,000 tubes every year. It is a cumbersome process to cut and remove damaged tubes and then replace them in huge numbers.

To overcome such highly maintenance prone inefficient air preheaters, it is proposed to replace them with new design, more efficient type and less maintenance prone rotary air preheaters and have the advantage of higher heat transfer. Presently the flue gas exit temperature at outlet of Air preheater varies from 150 to 180 deg C as against 137 deg C (design value)

Providing Oxygen analyzer at the outlet of APH will help in estimating the excess air- one of the most critical parameters.

Action to be taken:

Tubular air preheaters are inefficient . and they also require frequent tube replacement. It is observed that the existing tubular air preheaters are placed in third pass after the economizer. There is adequate space and structure available where new design rotary air preheaters can be easily installed.

It is as such proposed to replace the existing recuperative type tubular air preheaters with modern regenerative type rotary air Preheaters, having double lip sealing and automatic seal adjustment system, which is comparatively trouble free and more efficient in operation. Air leak losses will be drastically reduced. It is also proposed to install an oxygen analyzer at the outlet of the air preheater.

Advantages:

- Unnecessary hot air loss through flue gas path will be arrested.
- Unwanted cooling of hot flue gas will be stopped, resulting in additional heat transfer to combustion air
- Additional power required, for compensating leakage air, will be saved bringing down auxiliary power consumption.
- Faster detection of the air-preheater leakage, through the indication of oxygen content in flue gas, with the installation of oxygen analysers.
- Controlling Excess air to the Boiler
- Ultimate result in efficiency improvement in boiler operation, leading to reduced CO_2 emission through the stack.

11.2.6 Activity No. 6 (A-6 of Annexure 10)

Reduction in Auxiliary Power Consumption

11.2.6.1 Sub Activity No. 6.1 & 6.2

Coal Handling Plant (CHP)

Due to uncontrolled spillage of coal from coal conveyer belts, the CHP running time is extended much beyond the actual requirements. Auxiliary power input for CHP operation is substantially high.

The conveyor belts are designed at present to run at troughing angle of just 20 degree. Since the belt is more or less flat at 20 degree, more coal can not be carried. If the coal load is increased, coal starts spilling over the belt. By increasing the troughing angle spillage can be reduced. The conveyor capacity is 800 TPH. But on account of spillage the conveyors are run hardly at 600 TPH capacity. Due to this the conveyor system is run for nearly 18 Hrs a day to ensure complete filling of all raw coal bunkers. If the system is run at 800 TPH complete filling can be completed within 10 to 12 Hrs. Auxiliary power consumed in for nearly 8 Hrs additional period can be very well saved, by increasing the troughing angle to 35 degree.

More over spillage can be substantially reduced, by installing at all transfer points modified new design skirts. Presently steel plates are cut and fitted as skirts to prevent spill over at transfer points. The new design will have rubber pads with steel back up and these can be adjusted to the required height and gap. When worn out the rubber pads alone can be replaced. This may help in avoiding spillage problem to a great extent.

Action to be taken:

- Install modified adjustable rubber pads with steel back up to avoid coal spill over at transfer points.
- Increase the trough angle of the coal conveyors.

Advantages:

- By bringing down CHP operation by 6 to 8 Hrs a day nearly 5.0 to 6.0 Kwh of power per year will be saved.
- Coal wastage will be reduced as the spillage is stopped.
- Conveyors will be available for maintenance every day since the running hours will be reduced to 12 to 14 Hrs a day

11.3 Faridabad Thermal Power Station

Faridabad Thermal Power Plant is situated in the middle of the residential cum industrial town of Faridabad. It has three (3) units of 60 MW capacity. Steam generators and steam turbines are supplied by BHEL. These Units were commissioned before 1981. Due to ageing these units are derated to 55 MW each. The operating efficiency of units has deteriorated over the years. There is ongoing program, under Government funding scheme, to revamp and modernize these units, so that, considerable improvement in availability and generation could be brought in from the present level of operation. However to restore the efficiency to the rated design value some of the activities have been identified. With implementation of these measures, it is certain that the plant efficiency will show remarkable increase. There by the additional quantity of fuel, which is being fired at present may be saved and it would directly reflect on reduction of Carbon-Dioxide emission.

The list of various problems affecting the plant efficiency and remedial actions to be immediately implemented, are given below,

11.3.1 Activity No. 1 (Activity B-1 of Annexure 10)

Replacement of High Pressure Heaters with modified design and material (High pressure heaters are kept out of operation at present)

Applicable for the Units: All units (1,2,3)

Presently HP Heater tubes are made of carbon steel. Circular coil tube nest arrangement is adopted which is subjected to corrosion and erosion resulting in frequent tube leakage. HP heaters are required to be taken out of service for longer period due to repeated tube failures. Keeping HP heaters out of service, causes reduction in cycle efficiency Presently several tubes have already been plugged in HP heaters in all units. No more margin is left out for any further repair or plugging, unless the tubes are replaced.

Action to be taken

Replace the internal HP Heater tube bundle and supporting end plates by Stainless Steel material of latest design. This will overcome the problem of frequent tube failures. The modified design of tube bundles will have 'U' tube arrangement and the material of the tubes will be stainless steel.

The tube supporting plates are designed to give improved life. It is proposed to replace the entire HP Heaters along with heater shell.

Advantages:

- Improved overall cycle efficiency .
- Reduced maintenance
- Reduced Co2 emission due to improved efficiency and station heat rate.

11.3.2 Activity No. 2 (Activity B-2 of Annexure-10)

Modification of cooling water system for improving cooling water quality and condenser vacuum for all units and providing settling tank and clariflocculator

Applicable for the Units: 1,2 & 3

Present operating condenser vacuum for all units 1,2, & 3 is found to be very low and is not improving by any routine action. The condenser vacuum is supposed to be maintained at 0.11 kg/cm2, at 60 MW load. But condenser vacuum is presently maintained at 0.26 - 0.31kg/cm2 .

The problem of low vacuum in all units is because of scaling in condenser tubes affecting the heat transfer and air ingress into condenser through the flange joints in condenser. Though in the beginning when the units were new the condenser vacuum was good. With the passage of time , it is observed that there was gradual deterioration in condenser vacuum. During annual maintenance ,condenser inspections were carried out and found that the condenser tubes were fouled with salt deposits. It is observed that over the period the raw water quality taken from the canal has deteriorated. Due to habitation by the side of canal, lot of organic waste is added into the canal water. This has resulted in rise of BOD, COD, and EMA level in the canal water. At present raw water is treated in the clarifier of 3 x 400 m3/hr capacity but the treatment is not effective because of deterioration of raw water quality below the design. Clarified water from clarification unit is used to make up the system cooling water in the cooling tower. Due to in-effectiveness in the make up water treatment the BOD levels in the circulating water is alarming. The COD in cooling water system cannot be maintained, ultimately causing high turbidity and suspended matter in circulating water. Suspended solids and organic matters form scale in the heat transfer tubes of condenser resulting in reduction in heat transfer. To counter the problem of scaling, proper water treatment scheme needs to be implemented. Filtration is generally used in addition to regular coagulation method for removal of solids from the surface water or wastewater. The introduction of filtration unit in the circulating water would help in reduction of turbidity and suspended solids in the circulating water to the desired level and prevent the scaling problem in condenser. As a preventive measure a settling tank can be constructed to make the dirt and sand settle down, before the make up is taken to cooling tower basin directly. In addition for incoming make up water a separate clarifloculator can be installed for further coagulation and clearing of turbidity.

Action to be taken:

- Construction of settling tank and Clarifloculator for incoming make up water.
- Introduction of filtration unit in the circulating water system.
- Improve condenser cooling water chemical treatment methods and avoid scaling of tubes.

Advantages:

- Condenser vacuum will improve.
- Steam Turbine Heat Rate will improve substantially.
- There will be fuel saving and Carbon-Dioxide emission reduction.

11.3.3 Activity No. 3 (Activity B-3 of Annexure-10)

Introduction of Vacuum Pump for Air Evacuation system
Applicable for the Units: 1,2 & 3

Existing air evacuation system for condenser works with steam ejector. Auxiliary steam through PRDS is used for raising vacuum through ejectors. Due to inefficient performance of steam ejectors, condenser vacuum could not be maintained to required level. Due to various problems related to steam ejectors, such as, air in leaks in the system, enlargement of nozzles diameter in steam ejectors, problems related to condensate drain from ejector condenser to main condenser etc., the condenser vacuum has deteriorated over the period of operation drastically and is at very low level even at reduced loads. The steam ejector system is unable to maintain the expected vacuum in condenser, even with both the ejectors in service.

Vacuum pumps are found to be more effective in performance and are trouble free. By installation of vacuum pumps better vacuum can be maintained and the problems related to steam ejectors may be sorted out. However there will be marginal increase in auxiliary power, which comes as input power to vacuum pump and the same may be compensated with the other major advantages such as improved vacuum, trouble free operation, reduced maintenance and saving of steam.

Action to be taken

Replace the existing steam ejectors with vacuum pumps, for condenser air evacuation system.

Advantages

- Improved condenser vacuum
- Saving in heat energy by reduced steam consumption during starting which is expanded in atmosphere until unit is put into service.
- Improved reliability and efficiency of air evacuation system.

11.3.4 Activity - 4 (activity B-4 of the Annexure-10)

Composite Scheme for Boiler Efficiency improvement

Boiler efficiency mainly depends on the combustion regime in the furnace. Better the combustion, higher will be the boiler efficiency. For improving the combustion regime, it is essential to ensure that the coal pulverizers are operated and maintained in the best of their performance level. Further furnace heat absorbing surfaces are to be kept clean by regular soot blowing operation and automatic controls are to be tuned in order to get the best results.

Problems affecting the combustion and heat transfer efficiency are dealt with in detail hereunder:

11.3.4.1 Sub Activity No. 4.1

Upgrading milling system by replacement of existing hammer mills with BHEL make bowl mills Type XRP-623., incorporating modified fuel firing system of tangential firing and furnace safe guard system

Applicable for Units No. 1 & 2

The existing coal pulverizing system consists of Beater Hammer Mills. These types of high speed coal mills are not suitable for the type of coal being fired at the station. These types of mills are highly maintenance prone and the cost of spares and maintenance is found to be too high. Due to unexpected frequent break down of mills the unit generation gets severely affected. The beater hammers wear out very fast and need to be replaced very frequently. At times the hammers get broken to pieces and thrown inside the mill circuit. The broken pieces of the hammers cause severe damages to the ducting and fuel firing system. The mill shaft vibration goes beyond all allowable limits on uneven wear out of the hammers. Ultimately the mills break down, causing partial loading of the unit With the increased availability of coal mills the unit partial load operation will be curtailed. As a result the overall plant efficiency will improve.

Action to be taken:

In place of beater hammer mills, bowl mills (model XRP 623) may be installed. Technological feasibility of installing bowl mills has been studied by BHEL. However, for the installation of bowl mill in place of hammer mills, entire fuel firing system may also need to be modified. Only tangential corner firing system is suitable for operation with bowl mills. So it may involve major modifications on furnace pressure parts arrangements. The existing front wall firing system has to be removed and openings have to be created at the four corners of the furnace to accommodate the new firing system. The new bowl mills will have all the features of improved design along with the installation of dynamic classifiers.

By carrying this improvement in fuel firing system, the unit availability as well as operating efficiency will show remarkable improvement. The suggested modifications will bring tangible advantages, such as improvement in combustion efficiency, flame stability etc. With a stable furnace, forced outages due to combustion problems will be reduced, which in turn will improve the generation. The bowl mills require less maintenance as the life of mill internals is much more than that of hammers of beater mills. The modification suggested by BHEL includes the modern Furnace Safeguard Supervisory System (FSSS) also.

Advantages:

- Reduced maintenance
- Reduction in unburned in bottom and fly ash
- Better combustion
- Increased heat transfer

11.3.4.2 Sub Activity No. 4.2

Modification of existing bowl mills, by provision of rotating vane assembly in place of stationary one, along with installation of dynamic classifier, upgradation of PA fans and modification in hot air gate assembly to avoid hot air losses, to bring improvement in combustion efficiency

Applicable for Unit No. 3

The boiler of the third unit is fitted with Raymond bowl mills. The output and the fineness of pulverized coal deteriorates sharply with passage of time due to fast wear out of mill internals.. Due to non-availability of mills on many occasions the units are to be operated on partial load. Some of the problems faced in these mills are frequent jamming of journal assemblies, fast erosion and collar formation of grinding rolls, fast erosion of other mill components, frequent failure of scraper assembly, high mill rejects. inconsistency in coal fineness etc.

Due to erosion of bullring segments and grinding rolls, fineness gets deteriorated and the pass through on 200-mesh sieve falls below 45% against a specified value of 70%.

The existing coal classifier is static and integral with the Pulverizer. Classifier vanes get eroded very fast due to the passage of pulverized coal through them. Due to big openings in the classifier, the coarser particles get by passed and enter the outlet stream of the coal flow path of the classifier. Hence separation of coarser particles does not take place properly. Coarser particles pass through coal pipe and enter the furnace. Coarser particles take too long time for complete burning. Either they fall down to the furnace bottom along with slag or get carried away with the fly ash, affecting the combustion efficiency.

Action to be taken:

The existing coal mills are to be upgraded with the improved design features of the system, offered by BHEL. The modification of mills would involve replacement of grinding rolls with 'weld overlay' or 'high chrome grinding rolls', embedded with hardened carbide strips, replacement of bullring segments with modified bullring segments, with stringent specification on hardness, in superior chromium alloy, to suit Indian coal, which is abrasive in nature. Presence of quartz in Indian coal aggravates the problem by causing faster wear out of mill components. Another important change is the installation of rotating air port assembly in the mills, in order to limit turbulence inside the mill, which might help in reducing the wear out of mill components. These design changes in the milling system will improve the performance and increase the output of the mills, in addition to bringing in required consistency in fineness. The proposed modifications in the mills may result in improved life of the mill internals and in increased availability. With improvement in coal mill performance, stability in combustion will be established and support oil firing in furnace may considerably be brought down.

Further introducing re-designed coal nozzle buckets, revamping firing equipment accessories etc. will help in further improvement in combustion regime.

The existing classifiers will be replaced with new design of 'Rotary Vane type Classifiers', which are more efficient, in separating coarser particles and recirculating them into the Pulverizer. In rotary vane type classifiers, assembly is dynamic and keeps rotating at very slow speed. The speed and the vane position can be altered as per requirement. The classifier body will be lined with ceramic bricks to overcome body erosion and to improve the life of vane assembly.

Advantages:

- Reduced maintenance
- Reduction in unburned in bottom and fly ash
- Lower Auxiliary Power consumption
- Better combustion can be maintained
- Rotary vane type classifiers are more efficient in separating the coarser particles and recirculating them.
- Fineness of coal at classifier out let will be ensured at 70% pass in 200 mesh and 1% retention of coarser particles in 50 mesh
- Due to improved performance of classifier the unburned in bottom ash and fly ash will come down.

11.3.4.3 Sub Activity No. 4.3

Redoing of Boiler Insulation to avoid radiation losses

Applicable for the Units: 1& 2

The water walls of the boilers in Faridabad TPS are not membrane type. The tubes are hanging independently from top header to bottom header. The gap between the tubes is filled with firebricks and castable refractory. Due to dynamic action induced by vigorous combustion, there is always vibration in water wall panels which damages the refractory and firebrick.

As a result at many places the glass wool insulation has got dislodged and has become ineffective to contain heat. Hence the radiation heat losses have gone up.

Action to be taken:

Remove the damaged refractory and firebricks. Redo the entire refractory and firebrick work with new materials.

Remove the damaged boiler insulation and redo the insulation .

Advantages:

- Radiation heat loss will be reduced.
- Boiler efficiency improvement.

11.3.4.4 Sub Activity No 4. 4

Modification of Furnace Soot Bowling System

Applicable for the Units: 1,2 and 3

Soot Blowers are damaged and have become inoperative. Due to passing of steam valves of soot blowers, there have been many tubes failures. Some times blower lance gets stuck in the furnace, which would result in damage to tubes. Soot Blower control system has become outdated and is not in operating condition. Modern designs of digital controls, which can automatically come into operation, on detection of furnace fouling sensed through flue gas temperature probes can be installed in furnace.

Since soot blowers are not in working condition and are not being operated, the furnace walls and superheat coils are found fouled with build up of slag and ash. Due to unclean heat transfer area, heat transfer is very much affected.

More over due to ash and slag deposition, the fireside corrosion is on increase and several tube failures have already been experienced. It is absolutely essential to reinstall new soot blowers and practice regular soot blowing operation.

Action to be taken:

Replace all soot blowers with new modern design equipment.

Install modern digital auto control system for operating soot blowers.

Operate the soot blower system regularly.

Advantages:

- Reliable and high availability of soot blower system will help in keeping pressure parts in clean condition.
- High heat-pick up in furnace walls and super heater coils.
- Improved operation efficiency.
- Boiler outage due to tube failure will be avoided.
- By new and improved control system the soot blowers can be operated in automatic sequential operation.

- Auxiliary power consumption can also be reduced if the cycle of operation is only need based.

11.3.5 Activity No. 5 (B-5 of Annexure-10)

Replacement top & middle blocks of Tubular Air preheater by modified material and design and provision of oxygen analyzer after Air Preheaters in all the three units

Applicable in Units 1 & 2

Due to cold end corrosion and coal ash erosion, the air preheater tubes have thinned out and are punctured in many places. Due to corrosion effect seal welds are cracked and the tubes are becoming loose in the holes. As a result hot air leaks through the tubes in many locations. Due to short-circuiting of hot combustion air in to flue gas path, some amount of heat energy is wasted through stack resulting in high flue gas exit temperature.

Further there is considerable loss of airflow through the flue gas path. To compensate for the loss of combustion air escaping through the flue gas system. FD fans have to be subjected to overloading. ID fans are also overloaded, in order to handle addition mass flow resulting out of air in leakages . Hence auxiliary power consumption goes high.

Top and middle blocks of the Tubular Air Preheaters of units 1 & 2 are very badly damaged and hence require replacement.

Providing Oxygen analyzer at the out let of APH will help in estimating the loss of air. Oxygen monitoring in the stack is also one of the most critical parameters, which helps to estimate the extent of leakage in air preheaters.

Action to be taken:

To replace the air preheater top and middle blocks completely with modified air pre heater blocks in unit 1 & 2. The modified APH blocks will have tubes protruding by 50 mm from the tube blade and the gap between the tubes will be filled up with castable refractory which will protect the tube edges from ash erosions.

To identify all air leakage points in hot air ducts and in flue gas path. Rectify by replacing worn out ducting plates and warped and damaged skin casing plates This will improve the performance of Air Preheater by better heat transfer in APH, resulting in rise of temperature of primary and secondary air.

Install an oxygen analyzer at the outlet of the air preheater

Advantages:

- Hot air loss through ducts will be eliminated.
- Cold air leak into furnace and flue gas path will be eliminated.
- ID and FD fans loading will be reduced
- Ultimate result in efficiency improvement in boiler operation.
- Faster detection of the air-preheater leakage, through the indication of oxygen content in flue gas, with the installation of oxygen analysers.
- Controlling Excess air to the Boiler

11.3.6 Activity No. 6

Reduction on Auxiliary Power Consumption

13.3.6.1 Sub Activity No 6.1

ESP with semi pulse controllers

Applicable for the Units: 1,2& 3

Existing ESP controllers work on conventional method of the voltage control which requires more input power then modern semi pulse SCR controllers. Introduction of these controllers may reduce the Auxiliary power consumption and also improve the ESP effectiveness.

Action to be taken:

Replacement of existing controllers with the Semi pulse controllers in ESP.

Advantages:

- Auxiliary power requirements will be substantially brought down.

11.4 Guru Gobind Singh Super Thermal Power Plant, Ropar

Guru Gobind Singh Super Thermal Power Plant is situated at a site, adjacent to Bhakra Main Line Canal near village Ghanauli, 12 Kms from Ropar. It has six (6) units of 210 MW capacity (Stage I-1,2 units, Stage II – 3,4 units and Stage III – 5,6 units). Steam generators of all six units are of BHEL make, based on Combustion Engineering design. Turbo generators of all the six units are of Siemens (KWU) design and are supplied by BHEL. Though the units are being operated at rated capacity, the operating efficiency had deteriorated over the years. To restore the efficiency to the rated design value some activities have been identified under this scheme. The list of various problems affecting the plant efficiency and remedial actions to be immediately undertaken are given below.

11.4.1 Activity No. 1 (C- 1 of Annexure-10)

Replacement of High Pressure Heater Tube Bundle in the existing HPH shell with modified design and material

Applicable for the Units: 1,2,3,4,5 & 6

Present material of construction of HP Heater tubes is carbon steel. Circular coil tube nest arrangement is adopted, which is subjected to corrosion and erosion, resulting in frequent tube leakage. It is a perennial problem and very often HP heaters are kept out of service for very long periods on account of this. Keeping HP heaters out of service brings down cycle efficiency of the turbine and badly affects the station overall heat rate. HP heater tube leakage may endanger the turbine itself. Already quite a number of tubes are plugged and any further plugging will make the heaters more ineffective. Due to this problem, the heaters availability has got reduced by 20 %.

New design H P Heater tube bundle with vertical 'U' tubing arrangement and of stainless steel material have proven to be more effective and give better life. In the existing HPH shells new design tube bundles can be inserted with suitable modifications, after removal of the existing circular coil tube nest.

Action to be taken

Replace the internal HP Heater tube bundle and supporting end plates by Stainless Steel material of latest design.

Advantages:

- Increased availability of H P Heaters.
- Improved overall cycle efficiency .
- Maintenance cost is brought down

11.4.2 Activity No. 2 (C-2 of Annexure-10)

Modification of cooling water system for reduction of cooling water inlet temperature by installation of new Natural Draft Cooling Towers for units 5 & 6 and replacement of condenser tubes for units 2 & 4.

Ropar TPS has got 6 units of 210 MW capacity each. The plant had been developed in stages. Unit 1 & 2 were installed under stage I. Later under stage II unit 3 & 4 were put up. In third and final stage units 5 & 6 were added. At present, during rated out put of 210 MW of the units 5 & 6 of stage III, condenser vacuum is very low and is not improving by any routine action. The condenser vacuum is presently maintained at 0.14 kg/cm2 against designed vacuum of 0.12 kg/cm2 and is affecting the heat rate of the steam turbine.

The problem associated with low vacuum in unit 5 & 6 is generic problem related to the design of cooling water system of the plant. The cooling water system design is once through type with a cooling water pond arrangement for stage II & III units. Nearly 750 Cusecs of cold water is drawn from Bhakra canal and then directly taken at inlet to the condenser of stage I, units 1 &2. The outlet from stage I unit condensers, flows out through an escape canal and joins the storage pond of stage II. For stage II, units 3&4, the condenser inlet water is taken from this storage pond. The outlet of condenser of stage II units is discharged into another storage pond of stage III. Stage II and III storage ponds are interconnected.

Canal water entering stage I condenser, is at 23°C and the water at 34°C is discharged into pond of stage II. After mixing with some part of inlet canal water, the stage II pond water temperature remains at about 29°C The water at this temperature goes into stage II condenser inlet. Stage II condensers discharge water at 37 to 38°C into the stage III pond. The outlet water of stage II and some part of mixed water of pond II brings stage III pond water temperature at 36° C, which is drawn as inlet to condensers of unit 5 & 6.

The condenser design inlet water temperature is 30°C. But due to system design, the stage I units get water at very low temperature of 23°C and at the same time stage III unit condensers get inlet water at high temperature of 36°C. As a result, the stage I units have problem of under cooling and there is high rejection of heat, which is carried away by the cooling water. Whereas the stage III units suffer from inadequate cooling, since the water temperature at inlet itself as high as 36°C. Stage II and III cooling ponds are interconnected and there is no adequate flow of cooling water for make up to the hot water ponds of stage II and III. The entire draw of cold water from Bhakra canal flows into the stage I units.

There is no other solution but to install exclusive cooling towers for cooling down the water of storage pond of stage III to 30°C. Also separate intake branch canals are to be dug for carrying make up water into the storage ponds of stage II and III. Considering the geographical location of the area, it is proposed to construct Natural Draft cooling Towers for stage III. By installing cooling towers the vacuum problem of units 5 & 6 will be solved.

Further number of condenser tubes on Unit 2 and 4 have been plugged because of leakages caused by chemical erosion. It is proposed to change the existing Al-brass tubes with Cu-Ni tubes for better chemical resistance.

Action to be taken:

Construct Natural Draft cooling Tower for stage III condenser cooling water system. Further study is required for detail engineering,

Change the condenser tubes of units II and IV with Cu-Ni tubes.

Advantages:

- Condenser vacuum will improve.
- Steam Turbine Heat Rate will come down.

11.4.3 Activity No. 3 (C-3 of Annexure-10)

Modification of cooling water system to reduce under cooling

Applicable for the Units: 1, 2,3 & 4

Design cooling water inlet temperature of all units is 30°C. Stage I units 1 &2, being closer to the intake canal, are fed with very cold incoming water at 23°C, flowing from Bhakra canal, directly at condenser inlet. Since the condenser inlet water to stage I units is about 7 degree less then the designed temperature, there is very effective heat transfer and the condensate is cooled down below the saturation point. The exhaust hood temperature corresponding to design condenser vacuum of 0.12 is 49^0C. Due to better cooling effects, on account of entry of cold water at 23^0C, the condenser vacuum has improved to 0.09 Kg/cm^2 (abs). The exhaust hood temperature corresponding to improved vacuum of 0.09 Kg/cm^2 (abs) is 44^0C. The Condensate temperature in hot well should be equal to the saturation temperature corresponding to 0.09 Kg/cm^2 (abs), which is 44^0C. But as the inlet cooling water temperature is at 23^0C, condensate water in hotwell is cooled down to 37 - 38^0C instead of 44^0C. This clearly indicates that there is sub cooling of Condensate water by about 6 - 7^0C. In other words the Condensate, in hotwell, is losing considerable sensible heat, since it is cooled down

The sensible heat of condensate is lost to cooling water in condenser and is ultimately compensated into power cycle in the steam generator by burning extra coal, which means increased carbon dioxide emission into atmosphere.

The circulating water piping system is stand alone for each unit. For each unit two CW pumps are run. Due to problem of sub cooling, condenser inlet isolating valves are being throttled down in order to restrict flow to condenser. Modifying the CW piping and interconnecting them will help in running only three pumps for two units instead of running four pumps. This will avoid valve throttling to control the inlet flow to condenser and avoid the sub-cooling of condensate. Further it will result in substantial reduction in auxiliary power.

The above problem can be over come by suitably modifying intake water system. Make up water flowing in, through the intake canal may be modified to have three different branch canals connecting directly to the cooling water ponds of stage II &III , so that the cold water approaching from the intake canal can be divided equally in to two cooling water ponds. Unit 1 & 2 may continue to get fed directly from intake canal but the flow rate may be reduced.

Action to be taken:

Interconnect the condenser cooling water piping of each stage and make it into a common system. This will help to run minimum number of C W Pumps in the system and the throttling of inlet valve to Unit 1 & 2 can be avoided.

Modify the intake canal diverting the flow of cold water directly into the stage II & III storage ponds, so that the substantial amount of cold water will flow to the storage ponds, without sacrificing the requirements of inlet cooling water of StageI.

Advantages:

- By equal distribution of make up water to CW ponds of stages II & III, the inlet water temperature will be brought close to designed temperature of 30 Degree C for all the units.
- By avoiding sub cooling of condensate water in condenser in unit 1,2 considerable fuel saving will be achieved.
- This activity will help in improving the turbine cycle heat rate as well as over all station efficiency.
- Ultimate result is reduction of Carbon-Dioxide emission to atmosphere.

11.4.4 Activity No. 4 (C-4 of Annexure 10)

Composite Scheme for Boiler Efficiency improvement

Applicable for all units.

Boiler efficiency depends to a large extent on the combustion regime in the furnace. Better the combustion, higher will be the boiler efficiency. For improving the combustion regime, it is essential to ensure that a few important measures are taken, such as, coal pulverizers are operated and maintained well, furnace heat absorbing surfaces are kept clean by regular soot blowing operation, automatic controls are tuned to order.

Problems affecting the combustion and heat transfer efficiency are dealt with in detail hereunder:

11.4.4.1 Sub Activity No. 4.1 & 4.2

Modification of existing bowl mills, by provision of rotating vane assembly in place of stationery one, along with installation of dynamic classifier, upgradation of PA fans, replacement of coal nozzle assembly and modification in hot air gate assembly to avoid hot air losses.

Restoring Functionality of auto Burner Control System/ Master Control to bring improvement in Combustion Efficiency.

Applicable for all the Units

The boilers of these units are installed with Raymond bowl mills, XRP-803 in the unit 1,2,3,4 and HP-803 mills for Unit 5&6. The output and fineness of coal deteriorates very fast due to fast wear and tear of mill internals. Due to non-availability of mills on many occasions, the units have to be operated on partial load. Some of the main problems faced in these mills are frequent jamming of journal assemblies, fast erosion and collar formation of grinding elements, fast erosion of other mill components, frequent failure of scraper assembly, high mill reject, inconsistency in coal fineness etc.

Due to erosion of bullring segments and grinding rolls, fineness gets deteriorated and the pass through 200-mesh sieve falls down below 45% against a specified value of 70%.

In addition to revamping of coal mills, if some of the problems related to coal burner nozzle assemblies, bottlenecks in fuel firing system etc. are also attended to, the boiler efficiency will improve on account of improved combustion and greater flame stability.

Bad performance of coal classifier is yet another reason for disturbance in combustion region which is affecting boiler efficiency. This is a common problem in all the six units.

The existing coal classifier is static and integral with the Pulverizer. Classifier vanes get eroded very fast due to the passage of pulverized coal through them. Due to big openings in the classifier, the coarser particles get by passed and enter the outlet stream of the coal flow path of the classifier. Hence separation of coarser particles does not take place properly. Coarser particles pass through coal pipe and enter the furnace. Coarser particles take too long time for complete burning. Either they fall down to the furnace bottom along with slag or get carried away with the fly ash, affecting the combustion efficiency.

In addition to coal mill and classifier modification, some other activities, like revamping of Burner Tilt Mechanism, Secondary Air Damper Control, Oxygen Analyzer also need to be taken up.

All the boilers in Guru Gobind Singh Super Thermal Power Station are of Combustion Engineering design and are corner fired. In tangential firing, the fire ball position plays a great role in control of reheated steam out let temperature. The fire ball position, inside furnace, is determined by the burner tilt mechanism. Presently burner tilt mechanism is not functioning and the burner nozzles are kept fixed at one position. Major problem in the corner burner assembly is the fast wear out of coal burner components.

More over, coal particles, coal ash and refractory materials get entrapped into the transition piece and the coal nozzle interfacing. It is a curved surface over-lapping with very little clearance and when foreign particles get entrapped, they get stuck up. Due to exposure to very high furnace temperature, the moving components get distorted and cause obstruction to vertical movement. As a result the pneumatic actuator gets over loaded and starts malfunctioning. Further due to the sagging and the non-uniformity of the coal nozzle assembly over four corners, furnace temperature uniformity gets disturbed and consequently the combustion stability gets affected. It is essential to attend to the problems in the tilt mechanism and restore its functions to achieve improved combustion regime and better RH temperature control.

Coordinated master control for proper combustion in the furnace is also to be made operational . For this proper weighment of the coal being fed to the furnace is necessary. As such Gravimetric raw coal feeders are proposed to be installed .

For On-line monitoring of performance and efficiency of the boiler ,it is proposed to install DCS package for unit 3,4,5,6. For unit 1 and 2 FSSS system is proposed .Steam and water analysis system is also proposed to be revamped.

Secondary air damper control ensures proper wind box to furnace differential. Unless proper ratio of combustion air at a particular pressure and velocity is supplied, the combustion will not be proper. The damper control plays vital role in maintaining good combustion regime in furnace. Revamping the damper control system will help in improving the combustion efficiency.

Action to be taken:

The present coal mills are to be upgraded with improved design features , being offered by BHEL. The modification of mills would involve replacement of grinding rolls with 'weld overlay' or 'high chrome grinding rolls', embedded with hardened carbide strips, replacement of present bullring segments with modified bullring segments in superior chromium quality to suit Indian Coal. Another important change is the installation of rotating air port assembly in the mills to limit turbulence inside the mill, which may result in considerably reducing the wear out of mill components. These design changes in the milling system will improve the performance and increase the output of the mills, in addition to bringing in required consistency in grinding efficiency. The proposed modifications in the mills may result in improved life of the mill internals and in increased availability. Further introducing re-designed coal nozzle buckets, revamping firing equipment accessories etc. will help in improving combustion regime.

The existing classifiers will be replaced with new design of 'Rotary Vane type Classifiers'. The classifier body will be lined with ceramic bricks .

Action for introducing reliable air flow measuring device in secondary air duct.

Provision of gravimetric feeders on all the units

Installation of Microprocessor based FSSS and DCS package

Secondary air control device is to be rectified and made functional.

Repair and rectify secondary air damper operating mechanism.

Revamp and rectify the burner tilt mechanism with the improved design and use of high temperature resistance lubricants over moving surface.

Advantages:

- Reduced maintenance
- Lower Auxiliary Power

- Reduction in unburned carbon in bottom and fly ash
- Better combustion can be maintained
- Fineness of coal at classifier out let will be ensured at 70% pass in 200 mesh and retention of coarser particles in 50 mesh will be kept within 1%
- Due to improved performance of classifier the unburned in bottom ash and fly ash will come down.
- Safe and reliable operation.
- Hot reheat temperature automatic control will be made more effective.
- Reduction in oil consumption.
- Combustion control can be put on automatic.
- Reduction in CO_2 emission

11.4.5 Activity No. 5 (C-5 of Annexure-10)

Replacement of Air Preheater element by modified material and design having double lip seals and automatic seal adjustment system in Units 1,2,3 & 4 and provision of oxygen analyser after Air Preheater in all units

Due to cold end corrosion and ash erosion the air preheater elements get damaged very fast and the heat transfer efficiency gets badly affected. As a result the flue gas temperature after the air preheater goes high increasing the stack loss. Also the air preheater seals get worn out very fast, due to which the effectiveness of air sealing decreases. In order to compensate for the loss of combustion air escaping through the flue gas system FD fans has to discharge more air and the fan gets unduly overloaded. ID fan too gets loaded in order to meet the demand for handling additional mass flow. To overcome the problem of air leakage in the air preheater BHEL has developed new design of double lip, air seal arrangements with automatic seal gap adjustment mechanism. By installation of modified and improved design air preheater sealing system, considerable auxiliary power can be saved.

Air preheater elements are also redesigned with corten steel material and new profile baskets. These elements are more efficient in heat transfer and also resist wear due to ash and cold end corrosion. The life of Air preheater element will improve. Air leakage problems will be contained considerably.

Oxygen analyzers are installed to indicate the oxygen in products of combustion after the economizer in the flue gas path. Many of the oxygen analyzers are not reliable and do not indicate correct oxygen content. All these old design analyzers are to be replaced by most modern system.

It is also proposed to introduce additional oxygen analyzers after the air preheater, so that air in leak due to cold end corrosion and ash erosion of heater elements and that due to wear out of air heater seals to the flue gas path in air preheater can be exactly quantified. The installation of oxygen analyzers at the air preheater outlet will help the operator to know the extent of combustion air leakage in to flue gas path. Correct indication of oxygen is the only indicator for the level of excess air and in the absence of such reliable and proven analyzers it is difficult to maintain the exact requirement of combustion air. In the absence of such proven oxygen level indicators, combustion control and total air controls can not be not put on automatic operation.

Action to be taken:

- To replace the air preheater baskets with a modified design comprising higher weight of baskets with modified profile of heating elements and better material quality i.e. corten steel.
- To install automatic seal adjustment device and double lip plate sealing arrangement.
- Replace the existing non-reliable oxygen analyzers with most modern highly reliable oxygen analyzers.
- Introduce additional provision in the flue gas path for measurement of oxygen after the air preheaters

Advantages:

- Hot air loss through ducts will be eliminated.
- Flue gas stack losses will be reduced.
- Additional power required, for compensating leakage air, will be saved.
- Ultimate result in efficiency improvement in boiler operation.
- Reduction in CO_2 emission

11.4.6 Activity No. 6 (C-6 of Annexure-10)
Reduction in Auxiliary Power Consumption

11.4.6.1 Sub Activity No. 6.1
Variable Frequency Drives for I D Fans
Applicable for the Units: 1,2,3,4,5 & 6

The Flue gas flow is controlled by the inlet vanes of the Induced Draft Fans. The furnace draft control is totally dependent on this. The vane control is not precise and the draft control is not smooth. Resulting in reduced combustion efficiency.

There are three ID fans for each unit, each of which is designed to take 55% of rated capacity. Even at reduced load the fans continue to run at constant speed. The electrical input requirement is almost constant and adds up to the high auxiliary consumption.

Further the motor continues to run at constant speed irrespective of the change in load requirement. The Variable Frequency Drive will continuously track the load requirement and maintain the rotor speed to match the output requirement. This will result in huge saving in auxiliary power. The net power output to that extent will improve. The control will be efficient and smooth. This will ensure better efficiency in boiler operation

Action to be taken:

I D Fan motors have to be replaced. New motors with variable speed device are to be installed.

Advantages:

- Substantial reduction in Auxiliary power
- Better control of the furnace draft

11.4.6.2 Sub Activity No. 6.2

ESP with semi pulse controllers
Applicable for the Units: 1,2,3,4, 5 & 6

Existing ESP controllers work on conventional method of the voltage control which requires more input power than modern semi pulse SCR controllers. Introduction of these controllers will reduce the Auxiliary power consumption and also improve the ESP effectiveness.

Action to be taken:

Replacement of existing controllers with the Semi pulse controllers in ESP.

Advantages:

- Substantial reduction in Auxiliary power

ANNEXURE - 12

Activities Proposed to Overcome Technological Barriers

Table of Contents

12.1 TECHNOLOGICAL BARRIER NO. 1 2

12.2 TECHNOLOGICAL BARRIER NO. 2 4

12.3 TECHNOLOGICAL BARRIER NO. 3 5

12.4 TECHNOLOGICAL BARRIER NO. 4 6

12.1 Technological Barrier No. 1

Station:

Kolaghat Thermal Power Station
UNIT 1

Activity: (Activity A-1 of Annexure-10)

Replacement of complete HP and IP turbine rotors with latest improved design for better efficiency. Removal of Baumann stage and modifying LP cylinder complete with new LP rotor

a) Sub Activity 1

To enhance the LP cylinder efficiency by removing the Baumann Stage.

Technological Barrier:

The Baumann Stage was integral part of design philosophy of LMZ design turbine. Baumann stage was intended to take care of blade tip erosion in the last stages of the LP turbine. As a result Steam Turbine output and LP cylinder efficiency is reduced, since part of the steam gets bypassed directly to condenser.

For the first time a serious thought has been given for removal of Baumann stage to get the advantage of increased LP cylinder efficiency and the increased output. However such a modification has not been tried anywhere in the country. The power station authorities are hesitant to undertake such modification, since they are not confident about the outcome of such modifications. Moreover to carry out the Baumann Stage modification, a long shutdown (5 to 6 months) is required. It requires to be planned cautiously combining with many other retrofitting jobs to be undertaken in boiler and other areas. Further such modifications need huge financial inputs and the power stations are not in a sound financial position to take up this kind of job on their own.

Now the Original Equipment Manufacturer (OEM) has come out with technically viable solution. With the encouraging support and assurance given by the OEM, the power plant authorities are willing to go for such innovative changes.

Description of the problem & Suggestion for removal of barrier:

For a detailed description of the problem and suggestions kindly refer Annexure – 11, item No.11.2.1

b) Sub Activity 2:

Replacement of complete HP / IP rotor assembly of LMZ design of Steam turbine manufactured and supplied by BHEL, with newly designed modified rotor assembly, with reaction wheels.

Technological Barrier:

Original Equipment manufacturer has come out with a technical proposal of replacing the HP and IP rotors with improved design, which will ensure higher efficiency. It is technological advancement based on research and developmental activities taken up by the OEMs. The OEM stands guarantee to overcome the technological barrier for replacing the inefficient components of steam turbine with the technically improved design. It will lead to improvement in Heat Rate and consequent substantial reduction in GHG emissions. Further such modifications need huge financial inputs and the power stations are not in a sound financial position to take up this kind of job on their own.

Description of the problem & Suggestion for removal of Barrier:

For a detailed description of the problem and suggestion kindly refer Annexure – 11, item No.11.2.1

12.2 Technological Barrier No. 2

Station:

KOLAGHAT THERMAL POWER STATIONS

UNITS 1,2,3 & 4

Activity: (Activity A-5 of Annexure –10)

Replacement of existing Tubular Air Preheater with Rotary Air Preheaters of new design Double seal arrangement and automatic Seal adjustment, in the same location where the Tubular Air Preheaters are erected

Technological Barrier:

The tubular air preheater has its own disadvantages of puncturing due to ash erosion causing bypassing of combustion air into flue gas path. Due to this both F D Fan and I D Fans get overloaded. Auxiliary power consumption goes very high. To overcome the problem new design regenerative rotary type Air Preheaters are proposed to be installed in place of the tubular air Preheaters. This is a major modification and involves technological risks. In Kolaghat Thermal Power Station the existing Tubular Air Perimeters are located in a third pass and there are adequate structural members, which can carry the load of new design rotary Air Preheaters. These modifications would result in improved heat transfer and reduction in Auxiliary power consumption.

Description of the problem and suggestion for removal of the barrier:

For a detailed description of the problem and suggestion kindly refer Annexure – 11, item No.11.2.5

12.3 Technological Barrier No. 3

Station:

FARIDABAD THERMAL POWER STATION
UNIT 1& 2

Activity: (Activity B-4.1 of Annexure-10)

- Upgrading milling system by replaceing existing hammer mills with BHEL make bowl mills Type XRP-623., incorporating modified fuel firing system of tangential firing and furnace safe guard system.

Technological Barrier:

The milling system of existing boilers comprises of Beater Hammer Mills. The major disadvantage of Beater hammer mills is the very poor life of hammers which is only 180hrs, requiring frequent changes of hammers.Changing over to new design bowl type coal mills will be a major change in the existing milling system. It requires thorough study to retrofit totally a new philosophy design of pulverizing unit. Presently the boilers are front fired which is also proposed to be changed to tangential firing system. Such an attempt for total redesign of fuel preparation/firing equipment, in the same location and the available area has not been tried any where in the country. OEM has come out with an offer to carry out this modification.. So far the power plant authorities were reluctant to take this technological risk. With assurance and the guarantee given by the OEM in overcoming the technological barrier, station authorities are now prepared to go far such innovative changes. These changes will bring improvement in reduced maintenance, less down time, Partial loading operations etc.

Description of the problem and suggestion for removal of the barrier:

For a detailed description of the problem and suggestion kindly refer Annexure – 11, item No.11.3.4.1

12.4 Technological Barrier No. 4

Station:

GURU GOBIND SINGH SUPER THERMAL PLANT, ROPAR

ALL THE UNITS

Activity:

Providing Variable Frequency Drive system for ID fans .

Technological Barrier:

The Flue gas flow is controlled by the inlet vanes of the Induced Draft Fans. The furnace draft control is totally dependent on this. The vane control is not precise and the draft control is not smooth. Resulting in reduced combustion efficiency.

Further the motor continues to run at constant speed irrespective of the change in load requirement. The Variable Frequency Drive will continuously track the load requirement and maintain the rotor speed to match the output requirement. This will result in huge saving in auxiliary power. The net power output to that extent will improve. The control will be efficient and smooth. This will ensure better efficiency in boiler operation.

Description of the problem and suggestion for removal of the barrier:

For a detailed description of the problem and suggestion kindly refer Annexure – 11, item No.11.4.6.1

ANNEXURE - 13

ANNEXURE - 13
DETAILS OF ON GOING ACTIVITIES UNDER APDP SCHEME

	Activites Under APDP Scheme	Brief description of the Activity	Estimated Cost in Million Rupees
A	KOLAGHAT THERMAL POWER STATION		
1	Replacement of Air-preheater tubes - unit -2&3	Due to ash erosion and cold end acidic effect the Air Preheater tubes get damged and punctured. Combustion air short circuites through holes in the tubes. Hence 10000 tubes are replenched every year in each unit during annual overhaling	10.00
2	Replacement of economiser tubes - unit -2&3	Due to cold end corroson and due to ash erosion number of Eco. Coils are pitted or thinned out. There were several tube failures and the units had to be forced shut down. Hence complete economiser coil banks are proposed to be replaced.	10.00
3	Boiler structure repair & painting- unit 3	Due to atmospheric conditions the Boiler structures are withered and are getting rusted. Hence it is proposed to carry out repaires wherever required and repaint the entire boiler structure.	5.00
4	Acid cleaning of boiler water tubes-unit 3	Scaling of boiler water wall tubes, due to several years of operation. Due to scaling heat transfer is very much affected. It is required to go for acid cleaning of boiler tubes as per the tube analysis carried out.	6.00
5	Replacement of existing seal air fans (17 nos) - unit 1,2,3	The existing seal air fans are of overhang type. These are high speed fans and the bearing vibration goes high due to damages to bearings. Some times shaft bending too take place. Hence it is proposed to go for modified Seal Air Fans of simply supported arrangement, so that the break down will come down and maintenance work will be reduced.	3.70
6	Replacement of stator wedges by ripple spring wedges (Unit 1, 2 , 3)	The generator is of old design. The stator wedges often used to become loose and during annual overhaul wedges tightening used to be caried out. BHEL have come out with modification of stator wedges with ripple spring arrangements. It is proposed to carry out the modification in stage I units excluding unit 4.	15.00
7	Replacement of existing generator static excitation system - unit - 1, 2 ,3	The genrators of very old design and the excitation system and AVR control is through outdated design with slip ring arrangement. It is proposed to go for modern efficient system of static excitation control	15.00
8	Replacement of existing 6.6.KV MOCB by SF6 breaker Unit-3	The most modern and trouble free breakers are SF 6 breakeers and wolrd over only these breakers are now being operated. Hence suggested to replace the existing outdated MOCBs of 6.6 KV breakers.	15.00

ANNEXURE - 13

DETAILS OF ON GOING ACTIVITIES UNDER APDP SCHEME

[illegible]	Activites Under APDP Scheme	Brief description of the Activity	Estimated Cost in Million Rupees
9	Replacement of 132 KV (6nos.) & 220 kV (9 nos.) high level isolators	The isolators have become very bad due to aging and several repair works carried out time to time. They need repalcement.	6.00
10	Replacement of unit battery bank including chargers Unit- 1,2	The Unit battery bank is quite old and had lived up to its life. The battery performance has gone down drastically and requires replacement.	15.00
11	Replacement of existing analogue system with DCS with relevant field instrument & cables - Unit-3	Stage I is still being operated with old analog system supplied by IL Kota. The instrumentation and control system is outdated. Number of controls are not functioning on auto. If such controls are put on control unit operating efficiency will boost. Hence to revamp the existing control systems it is esential to switch over to Morden digital control system.	200.00
12	Replacement of existing Turbine Supervisory System by microprocessor based system	The Turbo supervisory system has become more unreliable. It is a very old system and is based on analog controls. Hence it is suggested to go for micro prossor based system.	60.00
13	Replacement of existing coal feeder drive (18 nos) by variable frequency drive.	Coal feeders are operated with PIV gears for speed control depending on fuel requirement. The change in speed is very unrealistics. Combustion control is not put into problem since proper speed variation and speed reference signal is not coming from the existing system. Hence it is proposed to go for variable frequency drives.	4.00
14	Installation of oxygen analyzer at air-preheater outlet for stage-I	Air preheater tubes get damaged and air in leak into flue gas path take place. Combustible air pass through flue gas path and the extent of such leakge can be detected and quatified only by way of measurring oxygen level in flue gas. At present only at air preheater inlet there is oxygen analyser. A new installation for oxygen measurement is suggested at airpreheater outlet.	4.00
15	Replacements of UPS battery banks and chargers	The UPS battery bank is quite old and had lived up to its life. The battery performance has gone down drastically and requires replacement.	3.00
16	Renovation of DM plant for stage-I, including installation of activated carbon filters	The DM plant of stage I is nearly 15 Yrs. Old. Rubber lining of number of vessels is to be replaced. Quite a few vessels are in a deteriorated condition due to fuming atmosphere over there in DM plant. Hence it needs to carry out renovation.	40.00
17	Renovation of cooling towers unit 1& 3	Cooling Tower drift eleminators and fills have got damaged and in many places fallen out. They have to be repalced completely with new design more efficient materials.	50.00

ANNEXURE - 13
DETAILS OF ON GOING ACTIVITIES UNDER APDP SCHEME

	Activites Under APDP Scheme	Brief description of the Activity	Estimated Cost in Million Rupees
18	Modification of electrostatic Ash precipitation system for stage-I	ESP control system is to be modified with electronic semi pulse low arcing design. This will help in reducing the auxiliary power consumption.	350.00
19	Installation of silencers for Boiler safety valve & steam injectors for stage-I	Silencers are damaged due to aging and requires to be replaced.	2.50
20	Installation of the dry Ash collection system for stage-I	Wet ash system is not working satisfactorily. Disposal of ash through slurry pumps and ash pipes through long distances has become a botheration. Hence it is suggested to go for dry ash collection system, so that collected dry ash can be directly stored in silos and dispatched for ash utilisation by prospestive users.	152.00
21	Installation of Dust Extraction system at Crusher House by vacuum pulling system	There is very much dust nuisence in CHP area. Existing dust extraction system with extraction fans is not working satisfactorily. The equipments have become inoperative due to erosion and environmental conditions. Hence a new vacuum system for removal of dust from crusher house area is proposed.	3.00
	TOTAL		969.20
B	FARIDABAD THERMAL POWER STATION		
1	Provision of Dry flyash collection system	Wet ash system is not working satisfactorily. Disposal of ash through slurry pumps and ash pipes through long distances has become a botheration. Hence it is suggested to go for dry ash collection system, so that collected dry ash can be directly stored in silos and dispatched for ash utilisation by prospestive users.	70.00
2	Replacement & Relaying of ash slurry lines I & II	Ash slurry lines are punctured over many places and big holes are formed due to ash erosion and corosion. Over straight lengths the pipe line effective bore is reduced due to build up of layer of hardened, unremovable ash deposit.	36.00
3	Provision of New plant air compressor for unit I & II	Compressors break down is on increase, due to wear and tear. They are not delivering rated capacity. Hence for augmenting air supply additional new compressor is to be installed.	2.00
4	Provision of Additional DM Plant of 2 x 30 T/Hr	Make up water requirement has gone up due to increased blow down and leakges. Leakages are vbeing arrested. But still there is need for additonal make up requirement. Hence a new	100.00
5	Provision Cf additional DM Storage Tank		2.50
6	Replacement of cables of T3 transformer from A2 Sub station to FTPS	Cables have spent their life. Requires replacement	7.00
7	Replacement of 10"NB line from CW header to suction LP/HP pumps	The 10" line is damaged and requires to be replaced.	1.00

ANNEXURE - 13
DETAILS OF ON GOING ACTIVITIES UNDER APDP SCHEME

	Activites Under APDP Scheme	Brief description of the Activity	Estimated Cost in Million Rupees
8	Replacement of passenger lift	Boiler is a tall structure. Frequently people go to drum level and other floors. Without passenger lift it, it will difficult to move around. For carrying materials it esential to have lift.	2.00
9	Provision of 15/10 MT EOT	EOT crane will facilitate turbine maintenace and carrying out overhauling jobs will be easier and fastertime and there by avaibility of the plant	2.00
10	Renorvation of chimney of unit I,II & III	Renovation of Chimney may improve the draughts in the boiler and thus improves the combustion. ID Fans is getting overloaded at present due to resistance offered. Renovation of stack will ease load on ID fan.	1.50
11	Renovation of cooling tower of unit 1,2 & 3	At present due to aging drift eliminators and fills are damaged and fallen out. Renorvation in the cooling tower shall improve the cooling water inlet temperature and thus improve condenser vacuum to some extent	3.00
12	Augmentation of storage capacity of Ash disposal area	Plenty of ash is getting accumulated and overflows. Additional facilities are to be made for storage of ash otherwise it may create environmental problem	10.00
	Total		237.00
C	**GURU GOBIND SINGH SUPER THERMAL PLANT, ROPAR**		
1	a) Retubing of surface condenser of GGSSTP for unit-2	Due to scalling and erosion quite a number of tubes were punctured and plugged. The fouling factor considered is just 15% and with the number of tubes already plugged the additional	30.00
	b) Retubing of surface condenser of GGSSTP for unit-4		30.00
2	Providing replacement spare, one number, for 210 MW Generators stator.	There are six identical units supplied by single vender, BHEL. If there is a Generator failure it may take at least 2 years to get new rotor and bring back the unit on line, since the lead time for supply of this item is very high. Hence it is recommended to have a spare stator for meeting any eventuality.	150.00
3	Providing replacement for 250 MVA, 15.75/220 KV Generator transformer	There are six identical Generator Transformers supplied by single vender. If there is a Generator Transformer failure it may take at least 1.5 years to get new transformer and bring back the unit on line, since the lead time for supply of this item is very high. Hence it is recommended to have a spare transformerfor meeting any eventuality.	60.00
4	Providing replacement for one number field breaker	There are six identical Generators supplied by single vender. If there is a failure of field breaker in the exicitation system, it may take at least 1 years to get new field breaker and bring back the unit on line, since the lead time for supply of this item is very high. Hence it is recommended to have a spare field breaker meeting any eventuality.	2.00

ANNEXURE - 13
DETAILS OF ON GOING ACTIVITIES UNDER APDP SCHEME

	Activites Under APDP Scheme	Brief description of the Activity	Estimated Cost in Million Rupees
5	Providing complete HPT module	Already in one of the units a HP Turbine rotor has got slightly bent and the run out is high. The same is being used with incresed steam flow path clearance. Hence there is efficiency loss. A spare H P rotor for six units is a must so that whenever any such rotor damage is noticed during overhauling, the same may be replaced and the defective one can be repaired and kept as spare.	80.00
6	Modification of water treatment plant at stage-I	D M plant was installed abcut 15 years back and has becomed very old. In many places rubber lining is to be redone. Some of the pipes are corroded and eroded in the acidic atmosphere prevailing in D M plant. Hence repaire and revamping is essential to set right the system to put it on rated out put operation.	1.00
7	Replacement of open/closed loop and measurement control system with Distributed Digital Control System having integrated facility of data acquisition system in units-1&2	Stage I is still being operated with old analog system which is available at present. The instrumentation and control system is outdated. Number of controls are not functioning on auto. If such controls are brought on automatic control unit operating efficiency will boost. There is no data aquicition system in the present Instrumentation configuration. Hence to revamp the existing control systems it is esential to switch over to Modren digital control system, incorporated with Data Aquisition system.	150.00
	Total		**503.00**

ANNEXURE - 14

ANNEXURE - 14

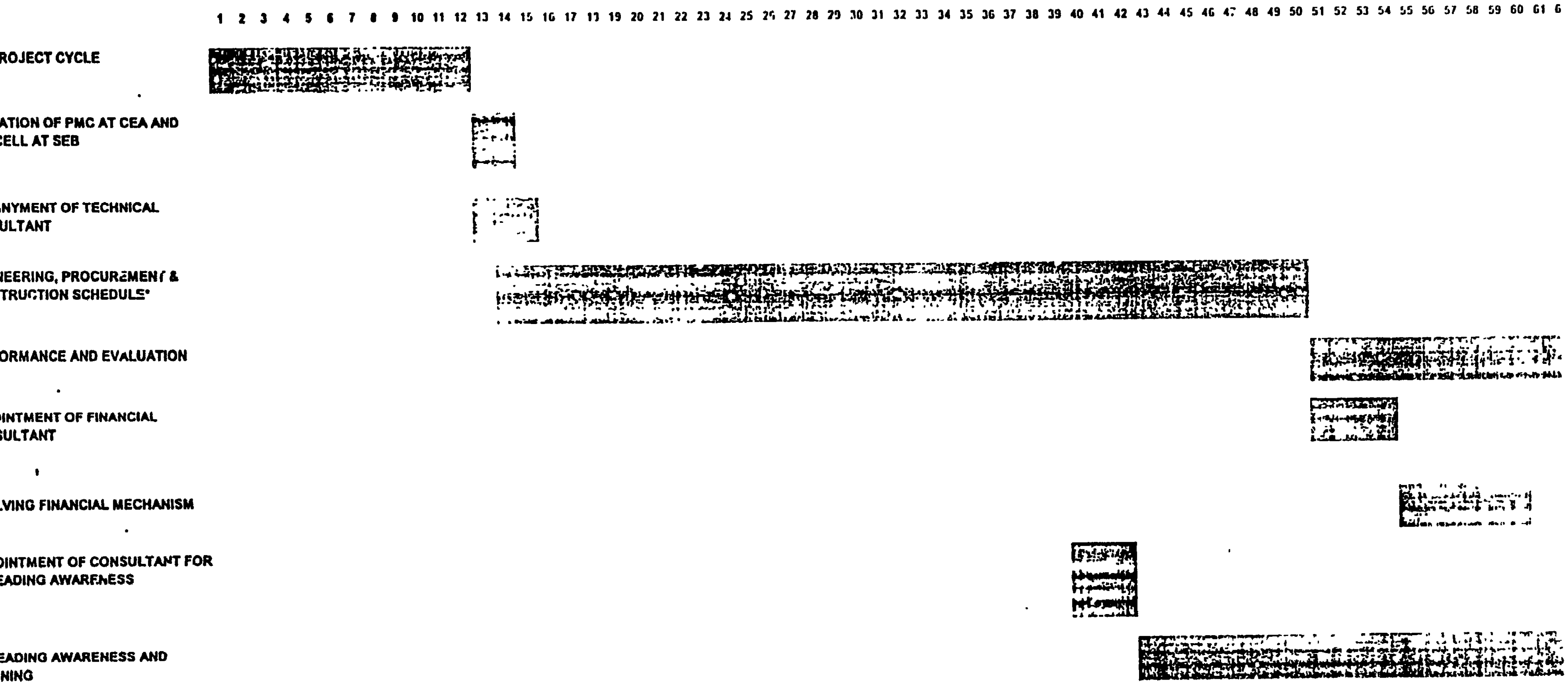
DISTRIBUTION OF RESPONSIBILITIES FOR IMPLEMENTING THE ACTIVITIES AT THREE IDENTIFIED POWER STATIONS

S.No	Activity	Agency involved
1.0	Formation of the Project Implementation Teams as well as Project Monitoring	CEA and SEB or utility company
2.0	Focal point for GEF/Implementing Agency	CEA
3.0	Implementation of Technical Schemes	
3.1	Appointment of consultant (one of each station) for engineering and assistance in project evaluation, monitoring and supervision services	SEB or utility company and CEA
3.2	Preparation of specifications	SEB or utility company, Consultant and CEA
3.3	NIT and tendering	SEB or utility company and Consultant
3.4	Bid evaluation and award of contracts for implementation	SEB or utility company and Consultant
3.5	Execution of technical schemes	SEB or utility company, Consultant and Contractor
4.0	Project Evaluation, monitoring and support	SEB or utility company / Consultant / CEA and contractor
5 0	Evolving Financial Mechanism	
5.1	Appointment of financial consultant	CEA , MoP, and SEB or utility company
5.2	Interaction with funding agencies/equipment manufacturers/ SEB or utility company/ other agencies	CEA and Financial Consultant
6.0	Increasing Awareness / Training	
6.1	Appointment of consultant	CEA , MoP
6.2	Organising workshops / seminars for spreading awareness	CEA , MoP and Consultant
6.3	Institutional training for power plant personnel	Consultant and CEA
7.0	Any further activity	CEA

ANNEXURE - 15

ANNEXURE - 15

PROJECT WORK PLAN



gineering Schedule is enclosed separately

O DATE FROM THE DATE OF SUBMISSION OF THE PROPOSAL TO GEF

Stabilizing Green House Gas (GHG) Emission From Indian Power Sector
Annexure - 15 Engineering Schedule for Guru Gobind Singh Super Thermal Plant, Ropar

		Year 1												Year 2												Year 3											
	ctivities to be carried out under GE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	**Improvement in Combustion Regime (units 1,2,3,4,5,6)**																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all six units			For all 6 units																																	
	receipt at site					For Unit 1						For Unit 2				For Unit 3						For Unit 4				For Unit 5					For Unit 6						
	installation and recommission											For Unit 1				For Unit 2				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
2	Air Preheater upgradation unit 1 to 6																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all six units			For all 6 units																																	
	receipt at site					Receipt of material before the start of the job of individual unit shut down (Lead time is 180 days)																															
	installation and recommission per unit											For Unit 1				For Unit 2				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
3	**Replacement of HP Heaters for Unit 1 to 6**																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all six units			For all 6 units																																	
	receipt at site					Receipt of material before the start of the job of individual unit shut down (Lead time is 180 days)																															
	installation and recommission											For Unit 1				For Unit 2				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
4	**Activities for improvement of condenser Vacuum (unit 5&6)**																																				
	Detailed Engineering and planning	■	■																																		
	placement of order for unit 5 & 6																						For unit 5 & 6														
	receipt at site																								For Unit 5				For Unit 6							
	installation and commissioning																												For Unit 5					For Unit 6		
5	**Interconnection of Unit 1& 2 to prevent subcooling**																																				
	Detailed Engineering and planning	■	■																																		
	placement of order for Unit 1 & 2			For unit 1 & 2																																	
	receipt at site					For Unit 1						For Unit 2																									
	installation and recommission											For Unit 1				For Unit 2																					
6	**Auxiliary Power Consumption Reduction (units 1,2,3,4,5&6)**																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all six units			For all 6 units																																	
	receipt at site					Receipt of material before the start of the job of individual unit shut down (Lead time is 150 to 180 days)																															
	installation and recommission											For Unit 1				For Unit 2				For Unit 3						For Unit 4				For Unit 5					For Unit 6		

Note 1 Receipt at site is a continuous process. Thus it is shown as long activities for all the units
Note 2 Sub activities are clubbed together with major activities

Stabilizing Green House Gas (GHG) Emission From Indian Power Sector
Annexure - 15 Engineering Schedule for Faridabad Thermal Power Station, Faridabad

•		Year 1												Year 2												Year 3											
	ctivities to be carried out under GE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	Improvement in Combustion Regime (units 1,2,3)																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all three units			For.3 units																																	
	receipt at site					For Unit 1												For Unit 2								For·Unit 3											
	installation and recommission											For Unit 1												For Unit 2								For Unit 3					
2	Replacement of HP Heaters for Unit 1,2 & 3																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all three units			For 3 units																																	
	receipt at site					For Unit 1												For Unit 2										For Unit 3									
	installation and recommission											For Unit 1												For Unit 2										For Unit 3			
3	Air Preheater Upgradation in Unit 1&2																																				
	Detailed Engineering and planning	■	■																																		
	placement of order			For unit 1&2																																	
	receipt at site					For Unit 1												For Unit 2																			
	installation and recommission											For Unit 1												For Unit 2													
4	Activities for improvement of condenser Vacuum (units 1,2 & 3)																																				
	Detailed Engineering and planning	■																																			
	placement of order all three units						For 3 units																														
	receipt at site								For Unit 1												For Unit 2								For Unit 3								
	installation and commissioning											For Unit 1												For Unit 2								For Unit 3					
5	Modification of ESP Controller																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all three units			For 3 units																																	
	receipt at site					For Unit 1												For Unit 2										For Unit 3									
	installation and recommission											For Unit 1												For Unit 2										For Unit 3			
6	Air evacuation system Modifiaction																																				
	Detailed Engineering and planning	■	■																																		
	placement of order all three units			For 3 units																																	
	receipt at site					For Unit 1												For Unit 2										For Unit 3									
	installation and recommission											For Unit 1												For Unit 2										For Unit 3			

Note 1 Receipt at site is a continuous process. Thus it is shown as long activities for all the units
Note 2 Sub activities are clubbed together with major activities

Stabilizing Green House Gas (GHG) Emission From Indian Power Sector

Annexure - 15 Engineering Schedule for Kolaghat Thermal Power Station, Kolaghat

	Year 1												Year 2												Year 3											
Activities to be carried out under GEF	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1 Improvement in Combustion Regime (units 1,2,3,4,5,6)																																				
Detailed Engineering and planning	■	■																																		
placement of order all six units			For all six units																																	
receipt at site					For Unit 2						For Unit 1				For Unit 3						For Unit 4				For Unit 5				For Unit 6							
installation and recommission											For Unit 2				For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
2 Replacement of Tublar air preheter to rotory heater																																				
Detailed Engineering and planning	■	■																																		
placement of order all six units			U-1 to 6																																	
receipt at site					Receipt of material before the start of the job of individual unit shut down (Lead time is 180 days)																															
installation and recommission per unit											For Unit 2				For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
3 Replacement of HP IP LP rotor in Unit 1																																				
Detailed Engineering and planning	■	■																																		
placement of order			U-1																																	
receipt at site					For unit 1																															
Installation and recommission															For Unit 1																					
4 Replacement of drip pump																																				
Detailed Engineering and planning	■	■																																		
placement of order all six units			For all six units																																	
receipt at site					For Unit 2						For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6						
Installation and commissioning											For Unit 2				For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
5 Activity for Improvement of condensor vacuum																																				
Detailed Engineering and planning	■	■																																		
placement of order all six units			For all six units																																	
receipt at site					For Unit 2						For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6						
Installation and recommission											For Unit 2				For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6		
6 Auxiliary Power Consumption Reduction (units 1,2,3,4,5&6)																																				
Detailed Engineering and planning	■	■																																		
placement of order all six units			For all six units																																	
receipt at site					For Unit 2						For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6						
Installation and recommission											For Unit 2				For Unit 1				For Unit 3						For Unit 4				For Unit 5					For Unit 6		

Note 1 Receipt at site is a continuous process. Thus it is shown as long activities for all the units
Note 2 Sub activities are clubbed together with major activities
Note 3 Unit 2 is taken ahead of Unit 1 in Kolaghat as it is required to retrofit of LP and HP & IP rotor. Thus this activity has long lead time for delivery of material at site.

ANNEXURE - 16

TTER FROM STAKEHOLDERS

r Kolaghat TPS
laghat Thermal Power Station
st Bengal State Electricity Board, Kolkata
B. Electricity Regulatory Commission, Kolkata
st Bengal Pollution Control Board, Kolkata
laghat Building Centre, Distt Midnapore
rum of Scientists, Engineers and Technologists (FOSET), Kolkata

r Faridabad TPS
ridabad Thermal Power Station
ryana State Pollution Control Board, Chandigarh
ryana Vidyut Prasaran Nigam, Panchkula
ryana Electricity Regulatory Commission, Panchkula
shtriya Chetnashakti Foundation, Faridabad
en Cross Society, Gurgoan

r Guru Gobind Singh Super Thermal Plant, Ropar
njab Thermal Power Station
njab Pollution Control Board, Chandigarh
njab State Electricity Regulation Commission
par Thermal & Ambuja Affected Committee (Ropar)

FAX MESSAGE
SEPTEMBER 08, 2001

FROM
SHRI S. P. DATTA
GENERAL MANAGER
KOLAGHAT TPS
FAX NO.(03228)50-280

TO
SHRI A. S. BAKSHI
DIRECTOR (C & E)
CENTRAL ELECTRICITY AUTHORITY
C & E DIVISION, ROOM NO. 314
SEWA BHAWAN, R.K.PURAM
NEW DELHI
FAX NO.(011)619 7267

MESSAGE STARTS :

PLEASE BE INFORMED THAT WE CONFIRM THAT KOLAGHAT THERMAL POWER STATION WILL IMPLEMENT THE ACTIVITIES TO BE FINALLY IDENTIFIED IF FUNDED BY GEF SCHEME(.)

MESSAGE ENDS :

(S. P. DATTA)
GENERAL MANAGER

Post copy in confirmation to :

01. Shri A. S. Bakshi, Director(C&E), Central Electricity Authority, C&E Division, Room No.314, Sewa Bhawan, R. K. Puram, New Delhi.

West Bengal State Electricity Board

CORPORATE OFFICE

Ref No. :.M(O)/25/356

Dated : 9 November, 2001.

To
The Director (TAD) & Nodal Officer for GEF Project,
Central Electricity Authority,
Sewa Bhawan – RK Puram,
New Delhi – 66.

Sub : UNDP/GEF Project in respect of Kolaghat Thermal Power Station (KTPS) for stabilising Green House Gas Emission for suitable development.

Sir,

This has a reference to your letter. No.17/SR/GEF/CE(TA)/CEA/2001 dated 1.11.2001 on the aforesaid subject.

We have gone through the relevant and related Project Proposal dated 6 July 2001, as submitted by Kolaghat Thermal Power Station of West Bengal Power Development Corporation Limited. The contents of the proposal appear to be in order. We are also of the view that the said proposal, if implemented, shall to a large extent contain Green House Gas Emission and shall be beneficial to ecological balance.

Yours faithfully,

(Dipak Ganguli)
Member (Operations).

"VIDYUT BHAWAN", BLOCK-DJ, SEC-II, BIDHAN NAGAR, CAL - 91 ☐ TEL. 359-1930 to 1940, 359-1941/1943/1944, 358-5292 to 5295
☐ GRAM : ELECTDEL ☐ TELEX : 021-4047-SEB-IN ☐ FAX : 359-1954

W. B. Electricity Regulatory Commission
FD-415A, Paura Bhavan, 3rd.Floor, Sector-III
Bidhannagar, Kolkata - 700 091
Tel : (033) 359-3553,3397 (O)
Fax : (033) 359-9720
: (033) 359-3397

No. ERC/ERC

Dated November 09 2001.

From:
Dr. R. N. Das, I. A.. S.,
Secretary, WBERC.

To
The Director And Nodal Officer for GEF Project,
Central Electricity Authority,
Government of India,
Ministry of Power,
SEWA Bhawan, Ramkrishnapuram,
New Delhi – 110066.

Sub : UNDP/GEF Project-Selected Option for Stabilizing Green House Gas emission for sustaining Development.

Sir,

I am to refer to your letter no. 17/SR/GEF/CE(TA)/CEA/2001 dated 23.10.2001 and fax message no. 17/SR/GEF/CE(TA)/CEA/2001 dated 7.11.2001 on the subject mentioned above.

I am directed by the Chairperson to inform you that this Commission has no suggestion to make at present on the above-mentioned project.

Yours faithfully,

(R. N. Das)
Secretary

WEST BENGAL POLLUTION CONTROL BOARD
(Department of Environment, Govt. of West Bengal)
Paribesh Bhawan
Bldg. No. 10A, Block-LA, Sector-III, Salt Lake City
Kolkata - 700 098
Tel. : 335-9088, 335-7428, 335-8211, 335-8073, 335-8731
335-0261, 335-8212, 335-8213, 335-8881, 335-5975
Fax (0091) (033) 335-8730/335-2813

DATED : 09-11-2001

MEMO NO.: 2930 -1A-148/2000

To
Shri M. S. Puri
Director (TAD)
& Nodal Officer for GEF Project
Central Electricity Authority
Ministry of Power
Sewa Bhawan, Ramakrishnapuram,
NEW DELHI - 110 066.

Sub.: *UNDP/GEF PROJECT - SELECTED OPTION FOR STABILIZING GREEN HOUSE GAS EMISSION FOR SUSTAINING DEVELOPMENT*

Ref.: *YOUR LETTER ADDRESSED TO THE CHAIRMAN VIDE NO. 17/SR/CE(TA)/CEA/2001/1656 DATED 25th OCTOBER, 2001*

Dear Sir.

In reference to your letter cited above I am directed to inform you that the Board supports your proposals for different units of Kolaghat Thermal Power Station (KTPS), Midnapore. There is no further comments from us at this stage. Further, I would like to inform you that the State Board has already directed KTPS to install emission control system and to meet the standard by October 2003 for Unit Nos.1,2 & 3.

Thanking you,

Yours faithfully,

(T. K. Gupta) 9|11|01
Senior Environmental Engineer (Planning)

KOLAGHAT BUILDING CENTRE

(Regd. No. - S/60230 of 1988-89 S. T. Regn. No. - TM/49214 Dt. 24-03-93)

To
The Director (TAD) & Nodal officer for GEF Project.
Central Electricity Authority
Sewa Bhavan, Ramkrishnapuram.
New Delhi - 110066

Sub:- UNDP/GEF Project - Selected option for Stabilizing Green House Gas Emission for Sustaingble Development.

Ref:- Your No. 17/SR/GEF/CE (TA)/CEA/2001/ dtd. 07.11.01

Respected Sir,

We are highly delighted in receiving your above mentioned letter seeking our Comments on the proposed measures taken for reducing Green House gas emission from KTPS.

Sir, we feel that the objective can be achieve by improving the functioning of different system by addition/alteration or modernisation as well as by reducing auxilliary power Consumption of the P/S which will reduce Consumption of Coal and fuel oil and thereby reducing the emission of Green House gas.

To achieve the goal, KTPS has already taken steps for modernisation of ESPs for different units and a number of steps proposed to be taken viz. Improvement of Boiler efficiencies, Renovation & modernisation of instrumentation system, Replacement of Turbines I.P. rotor for Unit no. I,

Contd. —

BUILDING CENTRE • FROM WASTE TO WEALTH • Estd. 1988

KOLAGHAT BUILDING CENTRE

(Regd. No. - S/60230 of 1988-89 S. T. Regn. No. - TM/49214 Dt. 24-03-93)

Contd. —

Upgradation of milling system, reduction of auxilliary power Consumption etc. We strongly belive that the proposed measures suggested will definetely reduce the emission of G.H. Gases to a great extent as such we welcome the effort being taken to achieve the goal to Protect the environment.

Thanking You

Yours faithfully

(G. C Mukherjee) 12/1.

Secretary

Kolaghat Building Centre

Head Office : 1, K. S. Roy Road 'B' Block, 6th Floor, Calcutta-700001

Office : Kolaghat Thermal Power Station, P.O. Mecheda, Dist, Midnapore-721137

FORUM OF SCIENTISTS, ENGINEERS & TECHNOLOGISTS (FOSET)
15N, Lindsey Street (5th floor), New CMC Building, Kolkata- 700087
Phone; (91) (033)252 9675,252 0521, Fax;(91) (033) 252 0521
Web Page ; http://www.foset.org E-mail: foset@vsnl.com
Kolaghat Sub Centre:
FH-1/7/3 KTPS T/S MEDINIPUR WEST BENGAL
Fax: 03228 50280; Phone: 03228 50895

To,
The Director (TAD)
& Nodal Officer for GEF Project
Central Elecuricity Authority

Sub: Comments on activities proposed for Stabilising Green house Gas Emission at KTPS

Ref: Your letter no. 17/SR/GEF/CE (TA)/CEA/2001/ Dtd 07/11/01
Discussion on 12/11/2001

Dear Sir,

We like to convey our gratitude for involving our organisation in such a important process. Unfortunately we got very insignificant time to comment on such a complicated & comparatively new subject.

In a fruitful discussion we had today with your Officials at KTPP guest house, the aims & activities of the project has been clarified. We find the project very useful & welcome the effort made to reduce Green House Gasses. We wish every success of the project & confirm all help & co-operation of FOSET to carry out the same.

We are enclosing some points for your consideration please.

Thanking you.
Yours faithfully,

(Sougata Chakravorty)
Secretary
Dated: 13·11·2001

Enclo: Comments (2 sheets)

COMMENTS OF"FORUM OF SCIENTISTS, ENGINEERS & TECHNOLOGISTS
Kolaghat Subcentre

Sub: UNDP / GEF Project – Selected Options for Stabilising Green House Gas emission for Sustainable Development at Kolaghat Thermal Power Station, West Bengal

In India as coal is the only abundant source of energy, the level of carbon emission from our ENERG SECTOR is a matter of concern. In conventional thermal power plants like KTPS, the areas o concentration for reduction of GHG are,

A) IMPROVEMENT OF SYSTEM EFFICIENCY
B) REDUCTION OF HEAT LOSS
C) REDUTION OF AUXILARY POWER CONSUMPTION
D) FUEL QUALITY
E) GENERAL CONCIOUSNESS

IMPROVEMENT OF SYSTEM EFFICIENCY

1. The *latest designed LMW Turbine* has higher efficiency than the LMW Turbines presently in service in KTPS. This improved efficiency will directly reduce the amount of fuel required to be burnt and as such the Green House Gases.We feel that the replacement of Existing internals by the modified Turbine internals to improve efficiency must be explored with indigenous as well as global manufacturers.

2. Presently the *Regenerative Feed heater no 5* is out of service for all the units 1,2, 3 for some initial design fault. These incurring huge losses. If drip of the of the regenerative heaters can be used in recommended manner then the cycle efficiency will be increased. Detail technical probabilities are to be explored to use the drip.

3. It has been seen that though regular soot blowing is done in the KTPS boilers, the ash deposition on the boiler tubes are still there. Incorporation of *Intelligent Soot Blowing System*, which basically monitors the temperature and starts soot blowing as per requirement will help to increase efficiency a lot.

4. In the absence of total air and fuel control specially with varying characteristics of coal ,it is difficult to run the unit with optimum excess air. Therefore, instrumentation for proper *auto- combustion control* is essential and has to be made operative. In addition, flame monitors provided have not been reliable. As a result operators prefer to continue oil support, resulting in higher specific oil consumption. It is essential to provide *reliable flame monitors* with redundancy and continuous self-checking features. In auto-combustion mode *gravimetric coal feeders* should be placed in place of volumetric coal feeders for knowing exact weight of coal to have better control over Auto Combustion.

5. In summer the condenser vacuum reduces drastically due to higher *Cooling Water inlet temperature*. This finally reduces the cycle efficiency. Thorough technical investigation & modification may be made to have desired cooling.

6. In present *Grid scenario* the KTPS units are running in part load for most of the time, which is affecting the cycle efficiency. The matter may not be in the purview of this project but may be considered in proper forum to reduce GHGs.

DUCTION OF HEAT LOSS

7. It has been experienced that tube leakage is taking place in quick successions in the Air Pre Heaters for the Unit 1,2,3,4. Which are recuperative in nature. These leakages allow the hot air to escape and overloading of the Induced Draught fans, which are causing efficiency losses. If these Air Pre Heaters can be substituted by the regenerative Air Pre Heaters, then the losses can be minimized and as well as the emission of the Green House gases.

8. Monitoring of some parameters at some more points of Boiler to reduce Green House Gas Emission. Carbon di Oxide, Carbon mono Oxide, Oxygen percentages are to be monitored at suitable locations. Flue Gases before & after both the Air Pre Heaters are to be monitored which needs more provisions of Instruments.

   The Quality and the reliability of the Instruments presently in use are not enough to monitor with highest possible degree of precision. These should be replaced by the best available in the world market. We agree to what Dr. **R.K.Pachauri, director,** TERI told in "OUR PLANET", vol 9 no. 6, 1998.

   "The developed countries have reached a point where market based instruments can be used effectively, since they have the institutional arrangements & mechanism to monitor & measure them properly. Developing countries will not be able to reduce Green House Gases unless their institutions also reach a reasonable level of development and the entire architecture for taking effective environmental protection measures each established."

REDUCTION OF AUXILARY POWER CONSUMPTION

9. Up gradation of Pulverisers Capacity: Presently all the 6 pulverisers are to be run to achieve full load due to so many factors for Unit 1,2,3. If the capacity of an individual Pulveriser can be increased in such a manner that 4 or 5 pulverisers can cater full load then Auxiliary consumption will be reduced by an appreciable margin and increase the availability factor and as such the sustainability.

10. Installation of Variable frequency drive for some equipments i.e. ID Fan, FD Fan, BFP can reduce auxiliary consumption radically.

    Forced Draught fans presently in use are of Centrifugal in nature with inlet guide vane control. If these can be replaced by Axial Flow fan with blade pitch control, the auxiliary consumption will be reduced by appreciable margin.

FUEL QUALITY

11. It is a common experience in a Thermal Power Plant that the coal received deviates from design values in terms of calorific values as well as ash content. This lower grade of coal finally loads the mills, fans, ESPs and as such hampers the combustion itself. Moreover the handling of excess coal is required. Thus the inferior quality of coal increases the auxiliary consumptions, Heat Loss and finall the Green House Gas emissions. Though it may not be in the purview of this project, the matter m by taken up with appropriate forum & modification of handling system to have consistent quantity at feeder with available coal may be thought of.

ERAL CONCIOUSNESS

2. The success of any project other than technical failure mostly depends on awareness of the users & beneficiaries. The subject being relatively new one, adequate measures are to be taken up to create general consciousness.

   In house workshops seminars demonstration are to be conducted to educate the users about the aim of the projects & technologists to be adopted. Brain storming sessions among employees & consumers & awareness campaign for energy conservation etc. may be arranged.

Thermal Power Station : Faridabad.
(A Unit of HPGCL)

From

The Chief Engineer/Thermal,
F.T.P.S., HPGCL, Faridabad.

To

Shri A.S. Bakshi,
Director,
Conservation & Environment Division,
Room No.314, Sewa Bhawan,
Central Electricity Authority, R.K. Puram,
New Delhi-110 066

Memo No Ch/3 /RNV-363
Dated: 26/9/2001

Subject UNDP – GEF scheme – Renovation & Modernisation of Thermal Power Station.

Please refer your letter no.CEA/TH/C&E/ENV/C/S/30/2001 dated 29 8 2001 regarding the subject cited above.

HPGCL hereby confirms to implement the activities identified at F.T.P.S. funded by GEF under UNDP – GEF programme.

This is for your information and further necessary action into the matter. please

Chief Engineer/Thermal.
FTPS, HPGCL, Faridabad.

HARYANA STATE POLLUTION CONTROL BOARD
SCO 11A & 12, MADHYA MARG, SECTOR 7-C, CHANDIGARH.

No.HSPCB/2001/ 4105 Dated: - 8-11-2001

To

The Director (TAD)
& Nodal Officer for GEF Project
Central Electricity Authority
Govt. of India (Ministry of Power),
Sewa Bhawan, R.K. Puram,
New Delhi-110066

Kind Attention: -Sh.A.S.Bakshi, Director, Central Electricity Authority. Govt. Of India (Ministry of Energy).

Subject: - **UNDP/GEF Project-Selected Option for Stabilizing Green House Gas Emission For sustaining Development.**

Reference your letter No. 17/SR/GEF/CE (TA)/CEA/2001/1665 dated 23.10.2001 on the above noted subject.

In this connection we are pleased to know about the Project Selected Option for Stabilizing Green House Gas Emissions for sustaining.development of M/s Faridabad Thermal Power Station at Faridabad, which is the main industrial town of the State of Haryana. The said Thermal Power Station has lot of scope for improvement of their operating efficiency /Environment Protection Systems as mentioned in the Annexure attached to the letter under reference. The eleven activities shown in the Annexure enclosed will definitely reduce the Green House Gases Emission from this Power Station at Faridabad.

You are therefore requested to go ahead with the said Project, as we have no objection rather we strongly support this Project, as it will improve the entire efficiency/global environment.

Please note that the above comments are only for the existing Thermal Power Station at Faridabad.

Environmental Engineer-I (HQ)
For CHAIRMAN

HARYANA VIDYUT PRASARAN NIGAM LIMITED

From

Managing Director,
Haryana Vidyut Prasaran Nigam Limited,
Panchkula

To

Shri M.S.Puri,
Director (TAD)
& Nodal Officer for GEF Project,
Central Electricity Authority,
New Delhi.

Memo No. 41/DIR/EDP-22 Dated: 9-11-01

Sub: **UNDP/GEF Project – Selected options for stabilizing Green House Gas Emission for sustained development.**

Please refer to your office letter dated 30.10.2001 on the subject.

We appreciate the initiative taken by the Government of India for promoting projects for improving the efficiency of Thermal Power Stations through R&M activities under GEF. We are pleased to learn that Faridabad Thermal Station has been identified as one of the four Thermal Stations where such a project would be implemented. We fully endorse the proposal, and look forward for its early implementation and consequent improvement in efficiency.

Director/Technical,
For Managing Director,
HVPN, Panchkula

HARYANA ELECTRICITY REGULATORY COMMISSION
SCO 180, SECTOR 5, PANCHKULA

From

Haryana Electricity Regulatory Commission,
Panchkula

To

Shri M.S.Puri
The Director (TAD),
Central Electricity Authority,
Sewa Bhawan, R.K. Puram
New Delhi. 110066.

Memo No.:HERC/T-80/
Dated: 12.11.2001

Subject:- UNEP/GEF project selected option for stabilising green house gas emission for sustaining development.

This has reference to your letters No. 17/SR/ GEF/CE(TA) /CEA 2001 /1662 dated 22.10.2001.

The Commission has no objection to such efficiency improvement schemes in the areas of power sector in the state of Haryana. However, the quantum of benefit to be achieved from this improvement is not clear from your letter and it is also presumed that the funding would be from GEF or other agency as a grant only and hence no cost burden would be passed on to the consumers and they would gain in terms of reliability and efficiency of supply after the scheme is implemented.

CEA should ensure Techno economic justification after taking into consideration the loss of generation during implementation period. The life extension activities should also be covered for these units which are about to complete their economic life span so that the efficiency benefits could be availed for longer period. The activities should be carried out during scheduled planned shutdown to avoid reduction in availability of power to consumer.

Secretary, HERC

Rashtriya Chetnashakti Foundation
House No. 1598, Sector 15
Faridabad, Haryana-121007
Telephone: (0129) 296852

Do No RCF/2001-2002/363

Dated 12-11-2001

Dr. Sukhbir Singh, IAS(Retd)
Chairman

Subject. - UNDP/GEF Project - Selected Option for Stabilizing Green House Gas Emissions for Sustaining Developmen

Dear Er Puri;

Thanks for your letter No 17/SE/GEF/CE(TA) CEA/200 dated 7-11-2001 received by us today, on the Subjects cited above

I have gone through your letter under Reference and I have also discussed this matter with you in detail.

Thermal Power Plant Faridabad is the largest air polluting unit in the Ballabgarh Faridabad area. The SPM at Ballabgarh on an average remains 450 $\mu g/m^3$. This figure for Faridabad (Sarai Khwaja) is about 400. Because this plant is Situated in the middle of the town the premissible limit for the SPM Should be 150 $\mu g/m^3$. Therefore SPM is much higher than the prescribed limit

PTO

The situation inside the Plant – Power House is even worse, here the SPM is more than 500 $\mu g/m^3$, which is adversely affecting the health of the workers.

Although the installation ESP in this Power House has mitigated the carbon/particulate emissions to a large extent yet due to frequent breakdowns and the process of restarting of the furnances by RFO makes the situation worse.

The effluent (water) coming out of the plant also has high quantity of flourides.

The plant is old. It needs to renovated and modernised. So that there are fewer breakdowns. There are leakages in the pipes which inject ash into air. These are also needed to be plugged.

If the quantity of CO_2 emmissions can be reduced, nothing like it.

I have discussed this matter with my Colleagues also and they fully support me in saying that with the above mentioned friendly observations we fully support the proposed R&M Activities under GEF Programme of the UNDP

With kind Regards,

Yours Sincerely

(SUKHBIR SINGH)
12-11-2001

Er M. S. Puri
Director (TAD) & Nodel Officer for
GEF Project, Sewa Bhawan, R.K. Puram.
New Delhi (Camp Faridabad)

Regn. No. 660/97-98
5413091
☎ 5236132 Fbd.
327278 Gurgaon

GREEN CROSS SOCIETY Regd.

H. O. : Shop No. 7, Arya Samaj Mandir, Arjun Nagar, Gurgaon
B. O. : 3F-89, N. I. T. FARIDABAD-121001

cs/FBD/2001/11-1

Dated 12-11-01

To
Sh.M.S.Puri
Director
Central Electricity Authority
Sewa Bhawan, R.K.Puram
New Delhi-110 066

Subject:UNDP/GEF Project-Selected Option for Stabilizing Green House Gas Emission for Sustaining Development.

Dear Sir

This is in reference to your letter Dated.07.11.2001 on the subject cited above.We the people of **Green Cross Society(Regd.)** lending it's little hand in the big fight against the Monster Pollution are pleased to know that the department is making serious efforts to control the effects of Green House Gases & for improving the efficiency of Thermal Power Stations through R&M activities under the GEF Programme.

We all know that the Faridabad Thermal Power Station a coal based plant and most importantly situated in the heart of the City is a bigger source of pollution and any step taken towards containing hazardous gases and improving the efficiency which in turn means lesser fuel consumption and hence lesser pollution, is heartedly welcome by our society.

In the fight against pollution we lend our full support,endorse the proposal as put forward by you in this letter and hope that the efforts made by you will move into the right direction with fullest of it's impact and be Implemented at earliest.

Branch Manager

PUNJAB STATE ELECTRICITY BOARD
GURU GOBIND SINGH SUPER THERMAL PLANT
P.O. Ghanauli, Distt. Ropar – 140 113 (Punjab)

Er. V.K. MOHINDRU
Chief Engineer

Fax: 01881-74232
01881-23010

No. 1184 /FE&T Dated: 19-9-2001

To
The Chief Engineer,
Central Electricity Authority,
Conservation and Environment Division,
Sewa Bhawan, R.K. Puram, New Delhi.

Sub: **PSEB -GGSSTP Project -**
UNDP - GEF Scheme - Renovation and Modernisation of Thermal Power Station.

Reference your memo No.CEA/TH/ENVC/5/10/2001dated 30-7-2001 and personal discussions held at Delhi on dated11-9-2001

In this respect, it is submitted as below:-

i) The total grant allotted for Renovation and Modernisation of GGSSTP under GEF Scheme will be utilized by PSEB and all schemes for the same are ready.

ii) List of the schemes as sent by your office are acceptable alongwith some additions as per site requirement.

It is requested that further action may kindly be taken.

Chief Engineer/O&M,
GGSSTP, Ropar.

CC. 1. Sh. A.S. Bakshi, Director(C&E), Central Electricity Authority,Conservation and Environment Division, Room No. 314, Sewa Bhawan, R.K.Puram,New Delhi for information.

2. Chief Engineer/Planning, PSEB, Patiala alongwith a copy of the letter received from CEA for further necessary action.

~~Encl: As above.~~

CC: SE(Tech) to Member/Generation, PSEB, Patiala alongwith a copy of the letter received from CEA with the request that the same may kindly be put up to worthy Member/Generation.

Encl: As above.

Phones :
Off : 01881-74238/ 23318/ 23010/ 71400
email : ceggsstp@hotmail.com

Phones :
Resi **: 01881-74228/ 23318/ 74999/ 71001**
email : vinod_mohindru@hotmail.com
ce_ggsstp@sify.com

PUNJAB
PUNJAB POLLUTION CONTROL BOARD
VATAVARAN BHAWAN, PATIALA
Ph: 215793, 215802. PBX: 227925, 200282, 200557, 200897 Extn. 215 FAX: 0175-215636
E-mail: info@ppcbonline.com or ppcb@ch1.vsnl.net.in Web: www.ppcbonline.com or http://www.punjabgovt.nic.in

No.26451 Dated. 20.11.2001

SPEED POST

To

The Director (TAD). &
Nodal Officer for GEF Project,
Central Electricity Authority,
Ministry of Power.
Sewa Bhawan. Ramakrishnapuram.
New Delhi- 110 066.

Subject: **UNDP/GEF Project-Selected Option for Stabilizing Green House Gas Emission for sustaining Development.**

Reference: **Your office letter no. 17/SR/GEF/CE (TA)/CEA/2001/1664 dated 23.10.2001 and No. 17/SR/GEF/CE (TA)/CEA/2001/1757 dated 7.11.2001.**

Enclosed please find herewith the details of activities proposed to be funded under GEF on the project related to Ropar Thermal Power Station for stabilizing Green House Gas Emissions for sustaining development. It is mentioned here that by the modification of various plants and machinery in the thermal plant there is expected that about 2,27,152 Ton per year of CO_2 will be reduced.

It is. therefore. recommended that the project relating to Ropar Thermal Power Station for reduction of Green House Gas Emissions to the environment be funded through the United Nation Development Programme (UNDP) of World Bank.

DA: As above.

Member Secretary

PUNJAB STATE ELECTRICITY REGULATORY COMMISSION
SCO 220 221, SECTOR 34, CHANDIGARH

The Director,
Central Electricity Authority,
Ministry of Power,
Sewa Bhawan, Ramakrishanpuram,
New Delhi – 110066.

Subject: **UNDP/GEF Project – Selected Option for stabilizing Green House Gas Emission for sustainable development.**

Please refer to your letter No. 17/SR/GEF/CE(TPA)/CEA/1938 dated December 5/6, 2001 on the above noted subject.

It is presumed that Punjab State Electricity Board has already considered your revised proposal including various activities mentioned in Annexure-II of the reference amounting to Rs. 1355 Million. Subject to the approval of the Board, the Commission has no objection for carrying out the efficiency improvement related R&M activities at Ropar Thermal Power Station under UNDP – GEF Project.

1/3/2k2
Secretary,
PERC, Chandigarh

ਰੋਪੜ ਥਰਮਲ ਤੇ ਅੰਬੂਜਾ ਪੀੜਤ ਕਮੇਟੀ (ਰੋਪੜ)

ਹਵਾਲਾ ਨੰ... ....

ਪ੍ਰਧਾਨ
ਨਿਰਮਲ ਸਿੰਘ ਲੱਦੀ ਮਾਜਰਾ
ਫੋਨ : 01881-74978

ਮਿਤੀ ..8/11/01
ਜਨਰਲ ਸਕੱਤਰ
ਸੁਰਿੰਦਰ ਸਿੰਘ [illegible] ਰਤਨਪੁਰਾ
ਫੋਨ ; 01881-74459

1) ਥਰਮਲ ਪਲਾਂਟ ਰੋਪੜ ਅਤੇ ਅੰਬੂਜਾ ਸੀਮਿੰਟ ਫੈਕਟਰੀ
[illegible] ਪੈਦਾ ਕੀਤਾ [illegible] [illegible] [illegible] ਥਰਮਲ ਦੇ [illegible]
ਨਾਲ ਪੈਦਾ ਕੀਤਾ ਜਾਂਦਾ ਪ੍ਰਦੂਸ਼ਣ ਨਾਲ ਇਲਾਕੇ ਦੇ ਲੋਕ
[illegible] ਰਤਨਪੁਰਾ [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] ਦੇ [illegible] ਦੇ
[illegible] [illegible] ਅਤੇ [illegible] ਦੇ [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] ਅਤੇ [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] ਥਰਮਲ [illegible] [illegible] ਪੈਦਾ [illegible]
[illegible] [illegible] ਥਰਮਲ ਦੇ ਪਾਣੀ [illegible] ਦੇ [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] 5000/ [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] / [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] (ਰਾਹੀ [illegible]) / ਰੋਪੜ ਥਰਮਲ
[illegible] [illegible] [illegible] ਅਪੀਲ ਹੈ ਕਿ GEF ਸਕੀਮ ਅਧੀਨ [illegible]
[illegible] [illegible] [illegible] ਪ੍ਰਦੂਸ਼ਣ [illegible] ਕੀਤਾ ਜਾਵੇ ਅਤੇ [illegible] [illegible] ਚਾਹੀਦਾ.

ROPAR THERMAL & AMBUJA AFFECTED COMMITTEE (ROPAR)

08.11.2001

Nirmal Singh
Village Lodhi Majra
President
Ph - 01881 - 74978

Surinder Singh
Village Nuhi Ratanpura
General Secretary
Ph - 01881 - 74459

We are hit by pollution created by Thermal Plant Ropar and Ambuja Cement factory. Pollution from Thermal Plant has affected the villages around viz. Lodhi Majra, Ratanpura Nuho, Bahadarpur, Alampur, Patial, Lohgarh, Raval Majra, Chandpur, Balavarpur, Chakdera, Dakala, Rajitpura, Panoli, Thavikalan, Aavipur, Madipur, Aaspur Majri, Kotwala etc. The cattle and agriculture of the villages have been hit by the pollution due to which there has been spread of diseases in the villages. The drinking water has also been polluted due to this hundred of acres of agricultural land has been spoiled due to waste water flow from the plant.

Farmers have been given compensation for the land @ Rs. 5000/- per acre only. Labourers have not been given employment in their plant (thermal).

This committee appeals that the GEF scheme should be implemented to reduce the pollution and other problems of ours should also be addressed.

Sd./-

Sd/-